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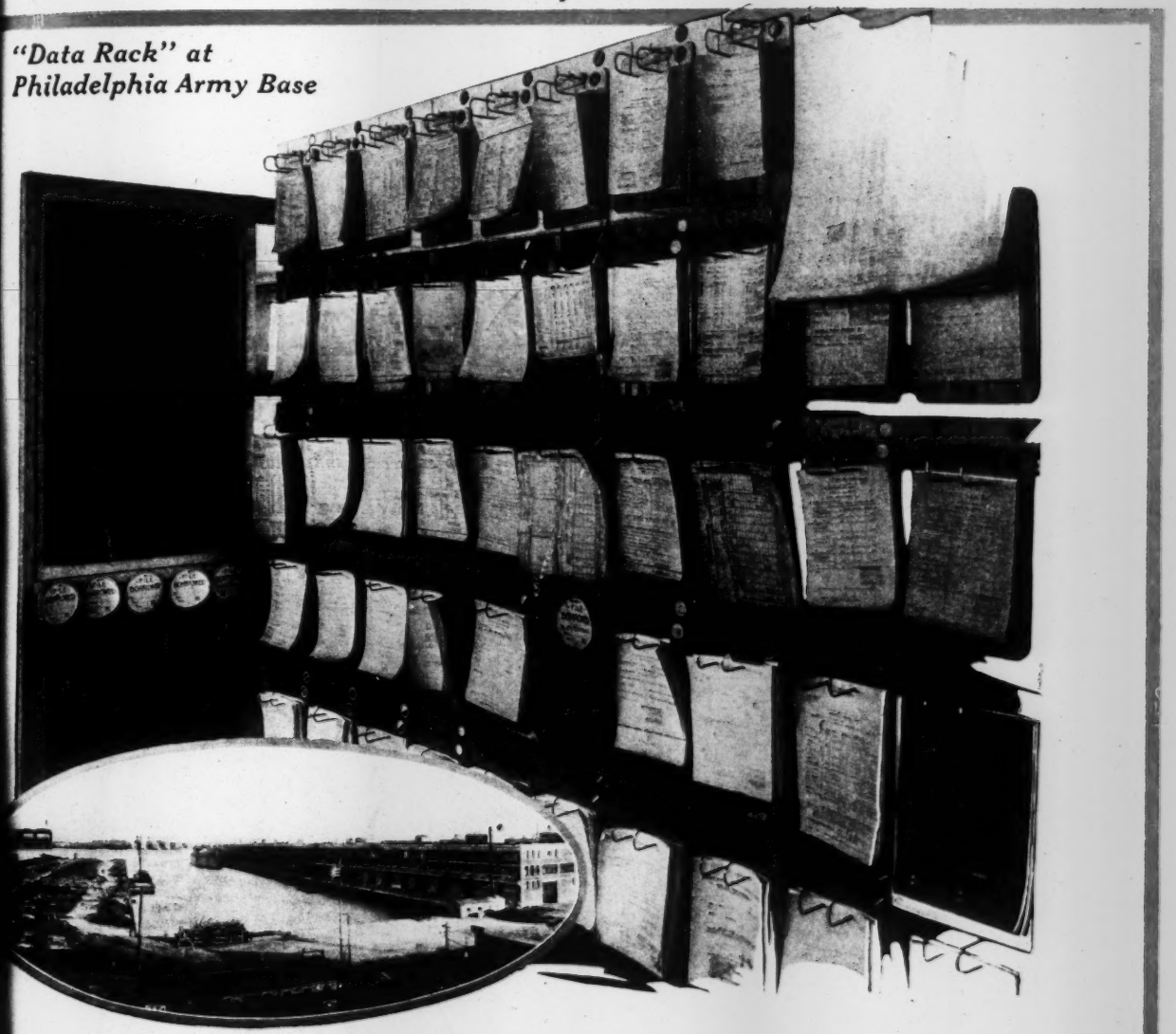


"Data Rack" at Philadelphia Army Base

The Leading Articles This Week Tell:

How a big job—the Philadelphia Army Base—was controlled by progress records.

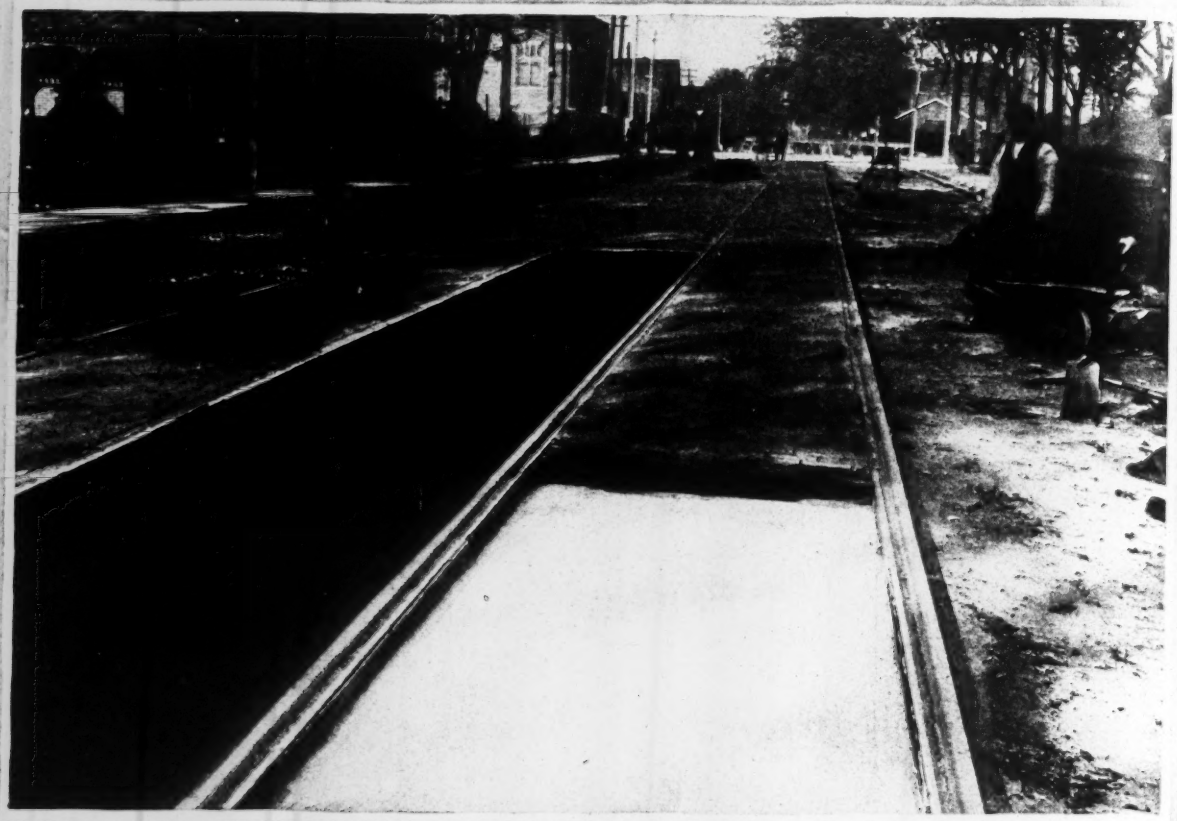
How all-sand aggregate for concrete roads proved a satisfactory substitute for broken stone.

How the business of carrying passengers and freight by motor in California has developed.

How old railway lines of the C. M. & St. P. were resurveyed to supply lost data.

KREOLITE LUG WOOD BLOCKS

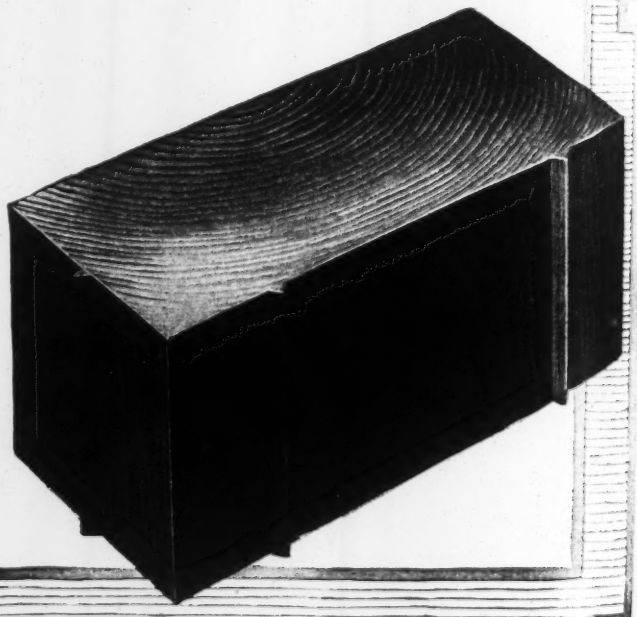
"The Paving that's Saving"



The Lug a Factor of Safety

Kreolite Lug Wood Blocks were selected in preference to rectangular blocks for paving between the rails and the dummy on Herkimer Street, Hamilton, Ont. because the Lug Block pavement automatically takes up all expansion; no danger of rails being forced out of alignment, or of the pavement buckling between the rails. As Lug Blocks give a good foothold horses will not slip and block traffic. Lug Blocks are safety blocks. They provide a grip for wheel chains and help prevent skidding.

The Jennison-Wright Co.
79 Kreolite Bldg., Toledo, O.



A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 84 — NEW YORK, THURSDAY, MARCH 18, 1920 — Number 12

No Bolshevism in France

WE HAVE had evidence in this country that, while reforms will continue to be demanded, our people want an evolutionary, not a revolutionary, procedure. There has been fear, though, that those nearer Russia would be more prone to the Bolshevistic method of accomplishing social reform. It is gratifying to note, therefore, that the breakdown week before last of the French railroad strike was due to the refusal of the French people to countenance a procedure which was generally regarded as a demonstration of a revolutionary movement. Incidentally, in the preceding week the Socialist Congress at Strasbourg refused by a vote of 2 to 1 to submit to the dictation of the Moscow radicals and disavowed Lenin and Trotsky. With further return to normal, both in Europe and here, the example of Bolshevism will become less and less potent. That will come not only through the removal of abnormal conditions, but through wider recognition that the communism of theory has not been translated into fact even under the Bolshevistic régime.

England and Direct Action

FOLLOWING the demonstration in France that the people would have nothing to do with Bolshevism came a test in England on the same issue. And the result there duplicated the French action. The miners voted, provided the unions generally would agree, to attempt to force the nationalization of the mines by direct action, that is, by a general strike. The proposal, laid before a specially convened Trades Union Congress, was voted down, the congress declaring in favor of political action—the use of the ballot. The vote was 1,050,000 for the general strike and 3,370,000 against it. On the other hand, by a vote of 3,732,000 to 1,015,000, the congress favored intensive propaganda on nationalization in preparation for a general election. While there is no doubt, then, of the strength of the sentiment for nationalization, English labor wants to bring it about by orderly means.

How Build Roads This Year?

WE commented recently on the high prices being bid for highway work. Not less noteworthy is the fact that very few bidders are appearing. In New York, Pennsylvania and Ohio some contracts have failed to attract any bidders. Facing this condition, State highway departments are asking how they can get even the vitally necessary roads built this season for, despite high costs, there are admittedly some roads that must be rebuilt—those that cannot be maintained with their inadequate surfacing under present traffic. There are but three answers to the question: Unit price contracts must be let at figures so abnormal that the contractor will be protected within wide limits of cost advances, the States must be willing to allow the contractor the actual increases in cost of materials, freight and labor, or the work must be done by force account. Of the three methods, the second is preferable. It permits of competitive bids on a unit-price basis. In practically all States the law, however, will not permit this form of contract. With legislatures in session in some States it is advisable to attempt to secure legislation permitting this form of contract to be used.

England and Foreign Trade

WE commented recently on the effect of adverse exchange rates in curtailing our foreign trade. Comment then was directed chiefly to the possible effect on domestic prices. Another effect, though, should also occupy our thoughts—that the trade which we will lose will go to other countries. They will be building up their foreign trade at the expense of ours. Of course more favorable exchange rates will be only one factor; Britain, particularly, will take the far-sighted view of extending liberal credits, a thing we have not learned to do. If one wants commentary on the probable future course of trade, he needs merely to reflect that the proposal to renew trade relations with Russia was an English suggestion, while the recent discussion of extension of credits to Germany in the Supreme Council of the Peace Conference is attributed, both as to origin and chief support, to Lloyd George. The rank and file in this country persist in considering the British Empire as a political entity. It is, in fact, a commercial entity. Just now, too, it seems to have more of a business administration than usual. Incidentally, the new British Ambassador to the United States was formerly head of the Board of Trade and bears the reputation in England of being thoroughly awake to all business problems, whether national or international. Here is ample food for thought, particularly as the appropriations committee of the House has just cut the appropriation for the work of our Bureau of Foreign and Domestic Commerce from $1,658,000 to $490,000.

Motor Transport in California

TO what extent the long-haul transportation of passengers and freight by buses or trucks in southern California has developed into an important *business*—not merely a jitney service—is indicated in Mr. Volk's article appearing elsewhere in this issue. The significant fact disclosed by his data is that these motor carriers are competing successfully with the steam and electric railway lines on fairly long hauls, and have, in fact, established a union terminal in Los Angeles for handling their passenger business. It is important in arriving at an estimate of the probable growth of motor transport in other localities, based on the California results, to keep clearly in mind two points which have a determining influence on the financial prospects for this form of service: In the first place, the climate in Cali-

fornia makes it possible to operate the motor bus lines the year round, and, secondly, the roads used—concrete with a thin wearing surface of asphaltic oil and screenings—are well adapted to motor traffic. In other colder regions, where snow and ice would interfere not only with the movement of vehicles, but also, in all probability, with the traveller's desire to make a long trip by motor car, the financial returns from an investment in motor vehicles and terminals might not prove attractive. Nevertheless, the results reported are additional evidence of the increasingly important place of the highway in the future development of the country. For the civil engineer the interest lies in the fact that he must build and maintain the track for this traffic.

Codifying Construction Management

CONSTRUCTION engineering is made up of a number of elements. First is the construction technic, that is the knowledge of how actually to reproduce in the structure the ideas conceived by the designer. This is the most common part of construction; it is possessed in increasing degree by the workman, the foreman, the superintendent and the master constructing mind. As the work increases in complication and magnitude the more important thing becomes the science of management, which includes cost control and the disposition of materials and labor so that there is a sufficient flow of both to insure a steady and economical progress of the job. This latter has, of course, been part of the equipment of every successful constructor, but the war, with its monster construction operations, developed the science materially, and what is more required a definite codification of what had been before more or less vague practice. Of such nature was the system of progress planning and recording used at the Philadelphia Army Base and described by Mr. Penrose on another page. This particular system has been criticized as being too elaborate, and indeed any brief description of it would give that impression. But it worked, and it required only a few men and cost relatively little, so that it is probably like many other complicated things—familiarity makes them simple.

Hoover for President

THIS is not the place for political discussion, but we may be pardoned for commenting on a presidential possibility when he happens to be an engineer—the first engineer, so far as we know, to be pressed for that exalted office, since George Washington, surveyor and soldier, was made President. Naturally the serious consideration of Mr. Hoover for the presidency is gratifying to all engineers, even to those who after a weighing of all factors, find they could not support his candidacy. If Mr. Hoover could go into the White House on his own terms and run the affairs of government untrammeled, as he did the Belgian Relief, or relatively untrammeled, as he did the Food Administration, he would give the country's administration a much-needed toning up. But it is the rare man who can go into the White House without heavy advance obligations. Not knowing Mr. Hoover's political affiliations, then, we can wish that Mr. Hoover, or a Hoover, could become President through a popular support so strong as to frustrate the machinations of the politicians. We think we would have little to fear but very, very much to gain through the leadership of a man who not only made monumental successes of the Belgian Relief and the Food Administration, but who in the year following the signing of the armistice helped put half a dozen embryonic governments on their feet. If demonstrated capacity to administer governmental affairs, grasp of the international situation and of fundamentals are criteria of presidential caliber, Hoover is the strongest man today.

Concrete Blocks and the Hudson Tunnel

A CONTROVERSY that was growing to be acute and personal has been quieted by the commission charged with building the Hudson River vehicle tunnel, through its decision against the much-discussed 42-ft. concrete-block tunnel plan. With regard to the technical questions involved, the decision is to be commended because it is favorable to progress, and in this particular enterprise nothing is so badly needed as prompt and rapid progress. Urgent necessity demands that a direct, short-cut crossing of the Hudson be provided at once. The ferries are congested; already their effect in throttling traffic and commerce is very serious, and it will become greater by the time the tunnel is ready to take traffic. The earliest possible inauguration of the tunnel connection, then, should be the present objective. But tunnels are not built by controversy.

With almost startling clearness the studies and discussions of the last few months established a fact that should have been self-evident yet had been all but universally ignored, namely, that there is the same need for highway connection of New York City with the New Jersey mainland as for connection of Manhattan with Brooklyn. Four great East River bridges constitute the Brooklyn connection, but there is no bridge across the Hudson. Here vehicle traffic must depend on ferries, and their capacity and speed limit the traffic. Direct street connection will at once increase this traffic in proportion to the improvement in facilities.

To show the earnings of the tunnel, its engineers estimated conservatively. Calculating on the basis of present traffic over the ferries, they found that the tunnel will be a gold mine. It will not only earn its keep but refund its entire cost in less than a dozen years. Yet only a short time ago anyone could have obtained charters and authorization to build this tunnel as a private money-earning venture!

Since the earning capacity of the tunnel was demonstrated, men engaged in freight haulage have asserted with strongest conviction that the actual traffic through the tunnel will vastly exceed the estimates. They predict that the four roadways of the tunnel will be fully taxed from the very day it starts operation; and this means that both the profits of the enterprise and the benefits it confers on the community will far surpass present expectations. Under such conditions it is certain that more highways across the Hudson must be constructed in a very short time; that the Canal Street tunnel will be but the first of a number of crossings.

Future tunnels can be built with clearer vision than the first one; the first step is notoriously the hardest, and we may be sure that the second and third Hudson River vehicle tunnels will encounter less opposition from apathy and from New York's well-known provincialism, and will not lag so far behind the demand, as does the present enterprise. In their construction, then, more leisure will be available for considering various rival

designs and procedures, and it will be more easily practicable to depart from engineering precedent in deciding on their method of construction.

To summarize the situation in blunt terms, we may say that it is not of first importance what the technical details of the Canal Street tunnel project are, so long as they are sound and so long as they assure uninterrupted and reasonably rapid progress. Further, it is unimportant what traffic capacity is provided. There has been much dispute as to whether two lines of traffic in each direction should be accommodated, or three, and in opposition to the tunnel engineers the advocates of three lines seem to have the better of the argument so far. But *Engineering News-Record* believes that all parties interested will gain much more by avoiding further loss of time in starting work than by seeking to attain the nicest adjustment of capacity at the cost of quarreling and delay.

If the commission's decision is commendable as being helpful to progress, it is also to be welcomed as a contribution to the adjustment of technical questions involved in the enterprise. The engineering reports so far published have not made clear just what constructional features of various proposals were objected to, except that the project recommended by General Goethals was condemned in its entirety. So far as could be judged, the chief engineer and the board of consulting engineers did not condemn a 42-ft. tunnel as such, nor a concrete-block tunnel shell, nor a structure of double-deck arrangement, but the combination of these elements, located and arranged as set out on particular drawings. It is a decided relief from the resulting uncertainty to learn through the commission's resolution that the essential objection is to concrete-block tunnel-shell construction in the Hudson River bottom, regardless of diameter and any other element.

Many strong reasons are advanced by the chief engineer and the board for their disapproval of concrete-block construction in the Hudson silt. Among the reasons is the claim of deficient strength. So far as this claim is a statement of expert practical judgment it carries great weight, although in view of the fact that tunnel structures have all been developed by the trial-and-failure method it would seem that a conclusive decision for or against concrete blocks would need to be based on actual trial or experiment. But in so far as the claim is based on stress calculations, the case made out is highly questionable.

So little is known about the stability of subaqueous soils surrounding a tunnel shell that figures of the kind cited by the board at a public hearing two weeks ago (for example, a shear of 1,192 pounds per square inch in the interlock of the blocks) cannot have much meaning, and runs risk of being actually misleading. Indeed, the calculations which yielded these figures, used by the board to condemn concrete-block construction, would equally condemn the tunnel recommended by the chief engineer and the board, and perhaps any other subaqueous tunnel.

In fact, we find ourselves here in a field of most remarkable technical uncertainty. The loading on soft-ground tunnels, and, worse still, on tunnels whose lower portion may in places bear on rock while the upper part is surrounded by soft material, is a thing of which we know very little, so a few pressure measurements (unpublished) are a feeble start toward supplying the required data. What may develop in the near future in the field of tunnel strength calculations is going to be well worth attention. In the meantime it may be hoped that the analytical studies made by the engineers of the tunnel commissions will soon be placed before the profession, in order further to develop this subject.

A Step Forward in Valuation

THROUGH a decision favorable to the railroad company, in the mandamus action of the Kansas City Southern R.R. to compel the Interstate Commerce Commission to admit evidence supporting costs of acquisition in determining land values, the Supreme Court of the United States, on March 8, pointed out the Commission's duty in carrying out the commands of Congress embodied in the Valuation Act. While the decision, as such, does not compel the application of current prices in fixing the "value" to serve as the basis of ratemaking under the new Interstate Commerce law (as many current newspaper reports indicated), it not only orders the admission of evidence in support of this contention but also commands that the terms of the act be carried out as to finding and reporting elements of cost which the Commission had refused to admit in connection with cost of reproduction. A step forward has been made in clearing the way to a final determination.

As indicated in the decision, printed in full on p. 563 the Court was not required to decide "a controversy growing out of duty performed under the statute" but "one solely involving an alleged refusal to discharge duties which the statute exacts." The railroad company had protested against the findings of the Commission in the tentative valuation, basing its complaint on grounds that "present cost of condemnation and damages or of purchase in excess of such original cost or present value" were not considered or included. The Commission then refused to admit additional evidence in support of the company's argument, citing its findings in the Texas Midland case which alleged the impossibility of carrying out the terms of the act in this respect, and which, in turn, referred to the Supreme Court decision in the Minnesota Rate Case as sustaining this viewpoint. Now the Court renders its opinion that the Minnesota finding was for a different purpose and should not affect the present case, particularly as it preceded the Valuation Act.

While the act calls for separate determination of (a) original cost, (b) cost of reproduction, (c) cost of reproduction less depreciation, and (d) other values and elements of value, the new railroad law does not prescribe what basis shall be used in building up the new rate structure. The possibilities of the decision, as regards a basis for rates, are so various that conjecture as to the outcome seems futile. Nevertheless, the importance of the decision is suggested by that portion of the Valuation Act itself which states that "final valuations by the Commission and the classification thereof . . . . shall be prima facie evidence of the value of the property in all proceedings under the act to regulate commerce . . . . and the various acts amendatory thereof, and in all judicial proceedings brought to enjoin, set aside, annul or suspend, in whole or in part, any order of the Interstate Commerce Commission."

Apparently an indictment of overzealous acts and improper assumption of authority by the Commission, the decision in the Kansas City Southern case clearly points out the Commission's duty. It marks a step in definite progress toward a final report on railroad properties.

Planning and Progress on a Big Construction Job—I

How Records Were Kept at Philadelphia Army Base in Order to Plan and Schedule the Work, to Follow the Progress of Construction, and to Control Future Operations

By Charles Penrose
Progress Engineer, Day & Zimmermann, Inc., Engineers, Philadelphia, Pa.

Materials, Labor and Administrative Charts

IN the administrative work related to progress of construction at the Army Supply Base at Philadelphia, there was developed a system of schedules and progress charts, by means of which, and along the lines of executive control of the project, the progress of the work was planned out and followed up from day to day and from week to week. All matters pertaining to progress were delegated to a department created for the purpose—the so-called Progress Department. The department was located in the field and was composed of a force of engineers and assistants forming part of the field staff of the Supervising Engineers.

It is the purpose of this article to describe the methods by which the problems presented were attacked, and to give some detailed description of the system of construction schedules and progress charts, and also, to explain the scheme that was worked out for reporting data of considerably varied nature and from a considerable number of sources. Attempt was made wherever possible to standardize this planning and progress work in a way which would be applicable to other large construction projects; and, within limits, it will be seen to be applicable also to some kinds of industrial enterprise. On the other hand, there is a tendency often to overdo such work as that about to be described and this should be guarded against; furthermore, it must be borne in mind that the scale of the project must be so large as to warrant extensive work of this character.

The first part of the present article treats of the Materials Charts, the Labor Charts and the Administrative Charts, and of the mechanism by means of which the Progress Department was run. In a succeeding issue there will be described those charts and schedules which had to do with the physical progress of the work and with the engineering data at the project.

Of the requirements in military construction work during time of war there stands out one requisite above all else—the requirement for speed. Of the necessities on any large construction project at any time and under all circumstances, a requisite is economy. Speed and economy were the objectives that led to the establishment of the Progress Department at the Philadelphia Base. Then, too, the territorial extent of the work demanded that the major divisions of the construction be formally planned and scheduled, and that careful report of progress be kept for executive information. The aid which systematic co-ordination could bring was perhaps increased by the fact that the project has been carried through by three organizations: the field staff of the Construction Division of the Army, under whose direction the Base was built, the field organization of the General Contractors, the Snare & Triest Co., and that of the Supervising Engineers, Day & Zimmermann, Inc.

At the outset of the construction, that is, in the midsummer of 1918, the Progress Department was established and at once began its work. The idea of such progress work in general was initiated by the Army, and throughout at the Philadelphia Base this work was developed and carried on in the closest touch with Lieut.-Col. E. B. Morden, U. S. A., the Constructing Quartermaster in charge of the construction of the project. It was largely Colonel Morden's constant encouragement and co-operation that lent impetus to the work, and it may be noted that the weekly charts were the form of report by the Constructing Quartermaster to the Construction Division of the Army, at the headquarters in Washington.

What the Philadelphia Base Comprises

Located on the Delaware River at Greenwich Point, the U. S. Army Supply Base at Philadelphia is one of the seven big port terminal developments along the Atlantic seaboard and the Gulf of Mexico put through by the Construction Division of the United States Army.

The project comprises deep-water docks, piers and massive 3-story warehouses; with utilities equipment, railroad facilities, a power plant, and an electrical substation. Its total cost has been about $13,500,000. Nearly 7,000 ft. of wharfage provide berthing space for loading or unloading twelve 500-ft. cargo-carrying vessels, or seventeen of the Hog Island type "A" ships. All slips are 35 ft. deep at mean low tide. With the two main piers respectively 1,500 ft. and 1,320 ft. long, the warehouse capacity at the Philadelphia Base as built is 145,000 tons of cargo, or the equivalent of 7,300 loaded box cars, assuming average loading of 40,000 lb. for each car; in other words, the contents of a freight train 55 miles long. This is exclusive of a railroad deck pier, designed for handling heavy ordnance pieces directly from cars into the holds of vessels.

During the period of construction, a Government Reservation was established at Greenwich Point that covered an area roughly twelve city blocks wide by twenty city blocks long.

The Philadelphia development, while it entailed construction work included under a considerable variety of phases of engineering, was essentially a civil engineering project. The predominating constructional operations were those of dredging, piledriving, wharf work, and reinforced-concrete warehouse construction—all on a large scale. Each of these operations is rather readily adapted to production scheduling and progress charting.

All of these operations were included in the Progress Engineer's charts of physical or work progress to be later described, especially as they related to the engineering data on the project. But there were other and readily apparent factors that entered into the construction organism. There was the material situation to be controlled, in itself at the time a complex situation; there was the human equation represented in the requirements for labor, its estimated capacity for construction accomplishment, its probable "turn-over" rate,

the co-ordination of labor classifications and payroll rates, the necessary supervisory force, and other factors entering into labor supply and demand; there were administrative features such as the status of routine work in the purchasing division, the equipment division, the transportation division, the auditing division, and in other departments of an administrative nature assembled on the estimated required quantities of materials, and the quantities respectively ordered, shipped received and "in place." Some *forty materials* entering into the construction were taken to be "principal materials."

Labor—The estimated labor requirements and actual labor supply, wage rates and expenditures, "man days,"

I: MATERIALS
II: LABOR
III: CONSTRUCTION EQUIPMENT
IV: PROGRESS
V: MISCELLANEOUS DATA
VI: FINANCE
VII: INDEX
VIII: PROGRESS PHOTOS
IX: GOVT. COSTS DIV.
PRINCIPAL MATERIALS
VALUE OF ALL MATERIALS ORDERED & RECD TO DATE TOTAL AMOUNTS
UNIT LABOR COSTS of CONSTRUCTION
MAJOR LABOR OPERATIONS "KEY CHART"
"SUMMARY" of DAILY LABOR GRAPHS
LABORERS' DAILY LABOR GRAPHS
CARPENTERS' DAILY LABOR GRAPHS
BRICKLAYERS' DAILY LABOR GRAPHS
PAINTERS' DAILY LABOR GRAPHS
MISCELLANEOUS TRADES DAILY LABOR GRAPHS
CONSTRUCTION PHOTOGRAPHS
WEEKLY PROGRESS PANORAMA PHOTOGRAPH
PRINCIPAL AMOUNTS
U.S. GOVT. DATA
FINANCIAL REPORTS
U.S. GOVT. DATA
CLAIMS
TRAFFIC & TRANSPORTATION REPORTS
DAILY WEATHER STATISTICS
DAILY DATA FOR ENGINEERS' DIARY
DATES OF START AND STOP OF WORK
PROGRESS DEPT.
FIELD AUDITOR U.S.Q.M.C.
PURCHASING AGENT
TRAFFIC DEPARTMENT
SUPERVISING ENGINEERS
OFFICE OF FIELD ENGINEERS
Jurisdiction of Commercial Division PROGRESS DEPT between these circles
Jurisdiction of Commercial Division PROGRESS DEPT between these circles
Addition of STATISTICAL Division
PROGRESS DEPARTMENT
KEY PLAN ZONES
PROGRESS PLAN ZONE "A" (WEEKLY)
PROGRESS PLAN ZONE "B" (WEEKLY)
PROGRESS PLAN ZONE "C" (WEEKLY)
PROGRESS PLAN ZONE "D" (WEEKLY)
DREDGING ZONE "A" (WEEKLY)
DREDGING MASTIAGE BASIN ZONE "C" (WEEKLY)
PILING ALL PIERS (DAILY)
PILING PIERS "B" & "C" (WEEKLY)
CONCRETE PIERS "B" & "C" GRAPHS (WEEKLY)
DREDGING DAILY GRAPHS (DAILY)
BRICKWORK ALL BLDGS GRAPHS (WEEKLY)
BLDG. PROGRESS ZONE "A" (WEEKLY)
BLDG. PROGRESS ZONE "B" (WEEKLY)
BLDG. PROGRESS ZONE "C" (WEEKLY)
BLDG. PROGRESS ZONE "D" (WEEKLY)
BLDG. PROGRESS ZONE "E" (WEEKLY)
BLDG. PROGRESS ZONE "F" (WEEKLY)
BLDG. PROGRESS ZONE "G" (WEEKLY)
BLDG. PROGRESS ZONE "H" (WEEKLY)
BLDG. PROGRESS ZONE "I" (WEEKLY)
BLDG. PROGRESS ZONE "J" (WEEKLY)
BLDG. PROGRESS ZONE "K" (WEEKLY)
BLDG. PROGRESS ZONE "L" (WEEKLY)
BLDG. PROGRESS ZONE "M" (WEEKLY)
BLDG. PROGRESS ZONE "N" (WEEKLY)
BLDG. PROGRESS ZONE "O" (WEEKLY)
BLDG. PROGRESS ZONE "P" (WEEKLY)
BLDG. PROGRESS ZONE "Q" (WEEKLY)
BLDG. PROGRESS ZONE "R" (WEEKLY)
BLDG. PROGRESS ZONE "S" (WEEKLY)
BLDG. PROGRESS ZONE "T" (WEEKLY)
BLDG. PROGRESS ZONE "U" (WEEKLY)
BLDG. PROGRESS ZONE "V" (WEEKLY)
BLDG. PROGRESS ZONE "W" (WEEKLY)
BLDG. PROGRESS ZONE "X" (WEEKLY)
BLDG. PROGRESS ZONE "Y" (WEEKLY)
BLDG. PROGRESS ZONE "Z" (WEEKLY)

FIG. 1. GENERIC DIAGRAM OF THE WORK OF THE PROGRESS DEPARTMENT ON THE PHILADELPHIA ARMY BASE

All subjects were divided according to the following index: I, Materials; II, Labor; III, Construction Equipment; IV, Work Progress; V, Miscellaneous Data; VI, Financial; VII, Index, etc.; VIII, Progress Photos; IX, Government Costs Division.

at the project; and, finally, there was the important item of unit costs of construction in the field.

In view of the above, and after analysis, the following phases were selected as those with which the planning and progress work would deal, and each constituted a section in the reports:

The Principal Materials entering into the permanent construction: namely, graphical information was to be labor "turn-over," "bonus hours" or overtime pay, overhead supervisory force, etc.

Construction Equipment—This section comprised reports on equipment in service and idle, such as dredges, piledrivers, rolling stock, concrete-mixing plants, etc., both rented and Government owned. Idle time for any equipment was particularly called to attention.

Shipments, Claims, Orders, etc.—Data were graph-

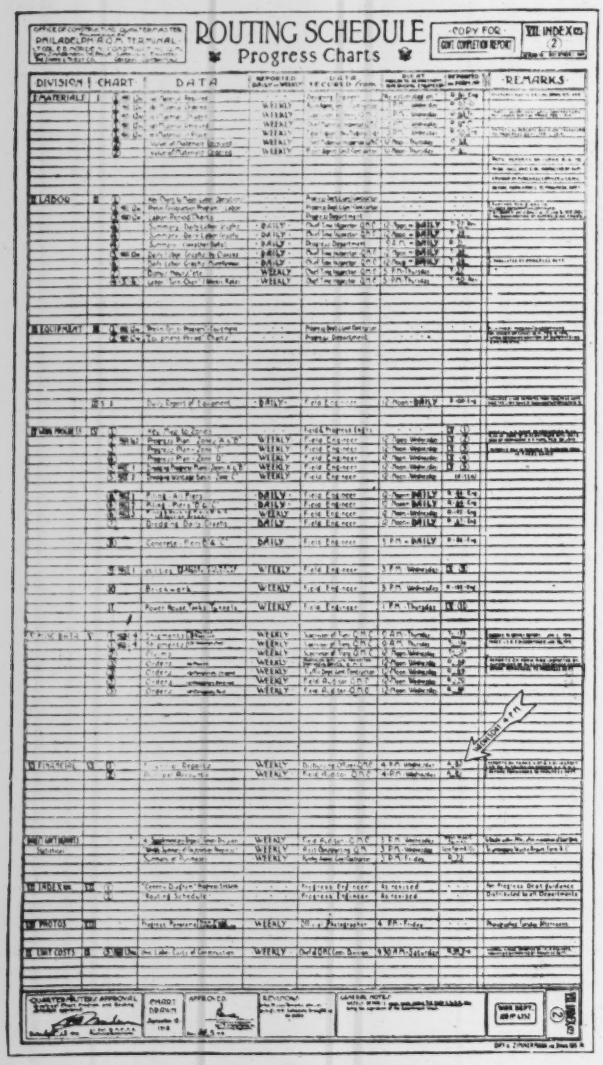


FIG. 2. FACSIMILE OF ROUTING SCHEDULE WHICH CONTROLLED PROGRESS AND PLANNING

Original size, 24 x 45 in. One of these large blueprints was posted in each department making reports to the Progress Department.

ically shown which would give the status of routine work in the respective administrative divisions handling these phases.

Financial Data—This section covered Government allotments or appropriations for the project, funds, liabilities, payments, etc.

Government Costs — Unit labor costs were shown graphically from data compiled by the Government Costs Division that was maintained in the field.

Progress of Work—Schedules and progress charts on a production basis were prepared for all of the major construction operations, and *progress plans* of the general condition of the project were reported by zones.

Progress Photographs were taken weekly from an established camera station.

In other words, the Progress Department, in addition to its function of planning, was to be made a clearing house for information pertaining to the engineering and physical progress of the work, as well as for information relating to the status of the whole administrative mechanism necessary to a project of the size. And as matters turned out, the department did become just such a clearing house.

The Progress Reports themselves as worked out were of two classes: *the graphical charts* and *the statistical reports*, and were compiled daily or weekly, according to the particular report. In every instance the form of graphical chart was preferred over that of statistical tabulations, because the graph by its use of curves and other symbols shows the rate of change and growth, as well as the present status, and moreover, permits the conditions to be visualized.

All graphical charts, that is, charts in which curves and progress symbols were employed, were made to standard dimensions and on tracing cloth, from which the necessary blue prints were secured. In those charts where color was used to advantage, the colors were added to the completed blueprints. All of this detail work was done by chart plotters and draftsmen.

Having determined upon the scope of the work and upon the character of report, the next step in organization was to work out a system whereby data which as already seen was of widely varied nature and from a considerably large number of sources, would be reported regularly to the Progress Department.

How extensive a system was necessary, is told in the chart called "Generic Diagram," reproduced in Fig. 1. The number of report forms required, by use of which the several sources reported data to the department, was upwards of two score! Referring to Fig. 1, it is seen that the Progress Charts themselves are grouped at the periphery of the circular diagram, each being embraced under its respective section designated by the roman numerals, such as "I: Materials," etc.; these several sections are listed in the "Index," also on the original drawing but here shown only in the caption. Obviously, the sections correspond with the divisions that have been briefly described already.

The *sources reporting data* for each Progress Chart, and the intermediate steps, are shown in order as one starts at the center of the diagram and works outward. In other words, the reader will observe that the 360 deg. of circumference immediately about the central emblem are divided into the three organizations in the field; namely, Construction Division of U. S. Army, General Contractors, and Supervising Engineers. Each

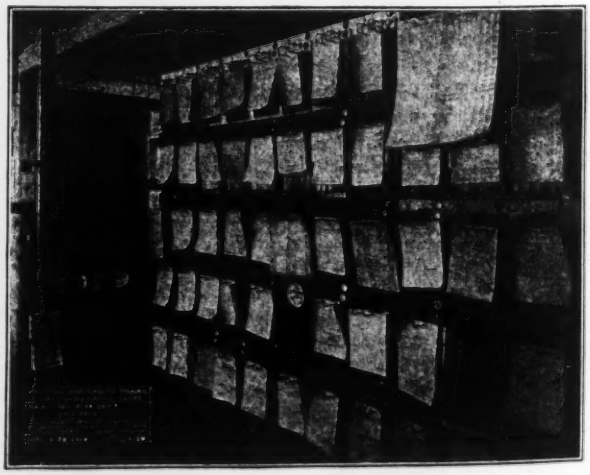


FIG. 3. DATA RACK IN THE PROGRESS DEPARTMENT

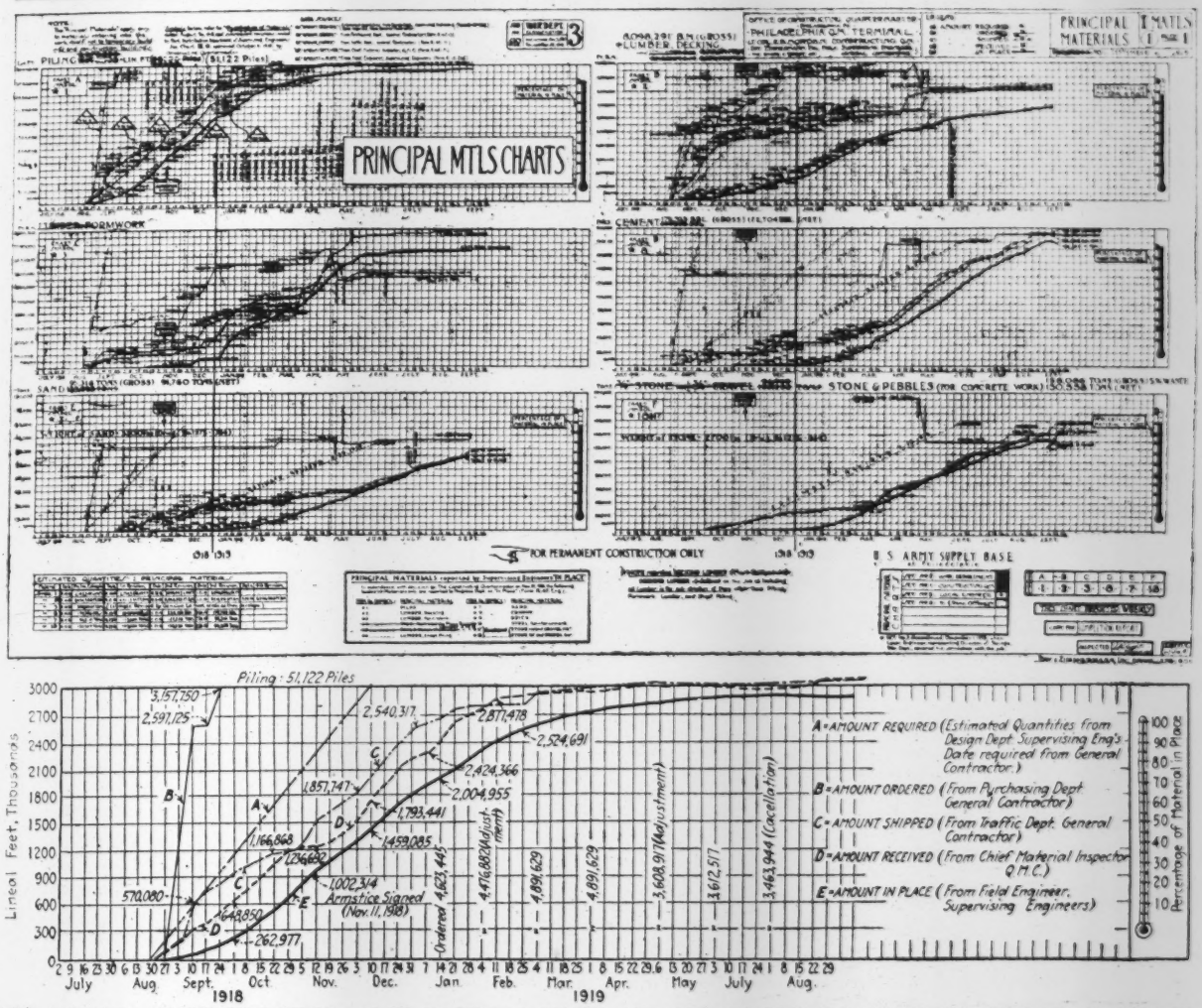


FIG. 4 (ABOVE). FACSIMILE OF 24 x 45-IN. MATERIAL CHART AND (BELOW) DETAILS OF PILING REPORTS SHOWN IN UPPER LEFT OF FACSIMILE

of these three divisions will be seen to be subdivided in the diagram into their several departments or engineering sections as the case may be.

Next in order, still referring to the diagram and proceeding outward, the name and form number of the various printed or mimeographed forms for reporting statistical data to the Progress Department are indicated, and also the fact whether a daily or weekly report. Directional lines with arrow heads show the routing of the form, either directly to a chart, where the data is shown graphically, or through an intermediate "computation" form necessary for digest by Progress Department or for calculations of averages, percentages, etc., by them. The jurisdictions of the two divisions of the Progress Department—that is, the Statistical Division and the Graphical Division — are also outlined. Their work was of considerably different character.

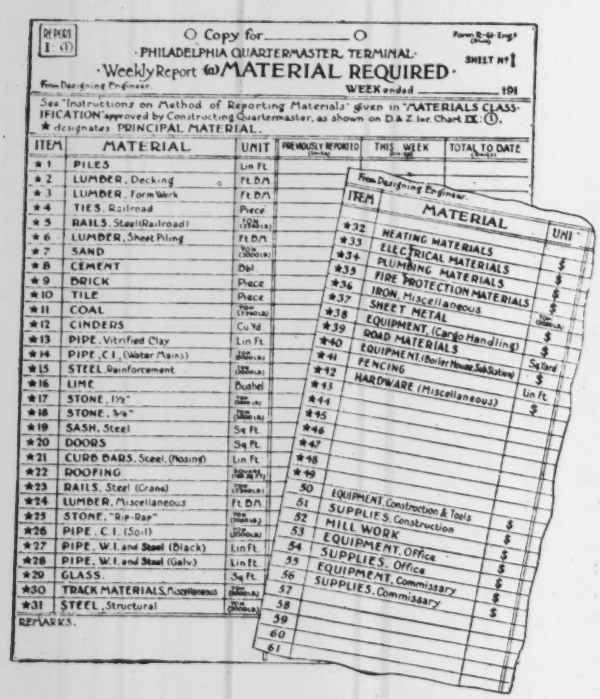
This diagram may appear involved. It is a fact, however, that the establishment of this definite routine for reports, and the general distribution and rigorous enforcement of a "Routing Schedule" which is about to be described, resulted in the whole progress work at the Philadelphia Base being rendered practically automatic in its routine operation. It also allowed the number of men on this part of the administrative work to be materially reduced after the development work of the department was completed.

The Routing Schedule referred to above is given in the table reproduced as Fig. 2. The schedule was designed to give both the "how" and particularly the "when" of making reports. It was drawn up on a 24 x 45 in. tracing, in poster form, from which blueprints were made and prominently posted in every office and department that was to make reports. Those reports which were expected from each, were called attention to in a way that could not be missed by large red cardboard arrows pasted on the blueprint and pointing to the particular form numbers, given in column headed "Reported on Form No." On each red arrow in large white lettering were given the day of the week and hour when due at Progress Department.

Regarding several details of handling information: Immediately upon arrival of these statistical information reports at Progress Department, a clerk stamped them in with time of receipt and filed them on the *data rack* illustrated in Fig. 3. The rack was made up in terms of the roman numerals previously given in the generic diagram (Fig. 1), and each section of files and the corresponding section of supporting rack were

painted in designating colors, in such a way that any file out of place would at once be evident. Actual postings of the progress chart tracings, or computations, etc., were made from the data to be found on the data rack. The rack cut down the number of men necessary for routine work.

When one stops to consider what 50,000 wooden piles, for instance, mean as a quantity of construction material —an equivalent of 2,700 railroad cars loaded with piling —and when this material is needed urgently on the basis of war necessity, he can see the executive value of centralized exact information as to the quantities of material "required," "ordered," "shipped," "received," and finally "in place" in the permanent structure, at the time. As a matter of fact, the aid actually given in controlling the material situation was immediate.



REPORT I (1)

Copy for _____

PHILADELPHIA QUARTERMASTER TERMINAL

Weekly Report (a) MATERIAL REQUIRED

From Designing Engineer. WEEK ended _____ 191

SHEET No. 1

See "Instructions on Method of Reporting Materials" given in "MATERIALS CLASSIFICATION" approved by Constructing Quartermaster, as shown on D & Z Inc. Chart IX. (1).

★ designates PRINCIPAL MATERIAL.

ITEM	MATERIAL	UNIT	PREVIOUSLY REPORTED (Cum'ive)	THIS WEEK	TOTAL TO DATE (Cum'ive)
★1	PILES	Lin Ft			
★2	LUMBER, Decking	Ft BM			
★3	LUMBER, Form Work	Ft BM			
★4	TIES, Railroad	Piece			
★5	RAILS, Steel (Railroad)	Ton (2000 lbs)			
★6	LUMBER, Sheet Piling	Ft BM			
★7	SAND	Ton (2000 lbs)			
★8	CEMENT	Bbl			
★9	BRICK	Piece			
★10	TILE	Piece			
★11	COAL	Ton (2240 lbs)			
★12	CINDERS	Cu Yd			
★13	PIPE, Vitrified Clay	Lin Ft			
★14	PIPE, C. I. (Water Mains)	Ton (2000 lbs)			
★15	STEEL, Reinforcement	Ton (2000 lbs)			
★16	LIME	Bushel			
★17	STONE, 1½"	Ton (2000 lbs)			
★18	STONE, ¾"	Ton (2000 lbs)			
★19	SASH, Steel	Sq Ft			
★20	DOORS	Sq Ft			
★21	CURB BARS, Steel, (Nosing)	Lin Ft			
★22	ROOFING	Square (100 Sq Ft)			
★23	RAILS, Steel (Crane)	Ton (2000 lbs)			
★24	LUMBER, Miscellaneous	Ft BM			
★25	STONE, "Rip-Rap"	Ton (2000 lbs)			
★26	PIPE, C. I. (Soil)	Ton (2000 lbs)			
★27	PIPE, W. I. and Steel (Black)	Lin Ft			
★28	PIPE, W. I. and Steel (Galv)	Lin Ft			
★29	GLASS	Sq Ft			
★30	TRACK MATERIALS, Miscellaneous	Ton (2000 lbs)			
★31	STEEL, Structural	Ton (2000 lbs)			

REMARKS.

From Designing Engineer.

ITEM	MATERIAL	UNIT
★32	HEATING MATERIALS	$
★33	ELECTRICAL MATERIALS	$
★34	PLUMBING MATERIALS	$
★35	FIRE PROTECTION MATERIALS	$
★36	IRON, Miscellaneous	$
★37	SHEET METAL	Ton (2000 lbs)
★38	EQUIPMENT, (Cargo Handling)	$
★39	ROAD MATERIALS	$
★40	EQUIPMENT, (Boiler House & Subst'n)	$
★41	FENCING	Sq Yard
★42	HARDWARE (Miscellaneous)	$
★43		Lin Ft
★44		$
★45		
★46		
★47		
★48		
★49		
50	EQUIPMENT, Construction & Tools	$
51	SUPPLIES, Construction	$
52	MILL WORK	$
53	EQUIPMENT, Office	$
54	SUPPLIES, Office	$
55	EQUIPMENT, Commissary	$
56	SUPPLIES, Commissary	$
57		
58		
59		
60		
61		

FIG. 5. FACSIMILE OF "MATERIAL REQUIRED" WEEKLY REPORT

Original in 8¼ x 10⅞-in. sheets

Fig. 4 shows the method employed in the weekly reporting of materials on one of the so-called "materials charts." The sheet containing these diagrams is 24 x 46 in. and contains curves for six of the principal materials. There is also shown a close-up of the piling diagram at the left upper part of the chart. Data graphed in these curves were reported to the Progress Department by five different divisions; namely, "material required" was reported by the designing engineer in the supervising engineers' organization; "material ordered," by the purchasing agent of the general contractors; "material shipped," by the Traffic Department of the general contractors; "material received," by the Government's material inspectors; and material "in place," by the field engineer in the supervising engineers' organization.

The way in which certain of these curves change in slope after the signing of the Armistice is interesting, and it, of course, denotes a corresponding change in rate of construction progress. Take, for instance, the heavy solid curve which shows quantity of piling "in-place": It will be observed as shown by the steep upward slope of the curve, that right at Nov. 11, 1918, the rate of progress in this part of the work had reached a maximum, and furthermore that the rate of progress fell off immediately thereafter, not again to be counterparted. So marked was this effect of the signing of the armistice upon various features of the work as a whole, that the date of cessation of hostilities was specially indicated throughout the Progress Charts, as will be seen.

The small "thermometer" scale in each materials chart gives the equivalent *percentage* of the material "in place," and is based upon the data which the corresponding curve gives in terms of unit of quantity. These thermometer scales likewise were found useful to be employed throughout the charts.

Two tabular sheets are shown in Fig. 5, which together comprise one of the statistical report forms, by which materials data were reported weekly by the various sources, and from which the corresponding curves were plotted. The units used were printed on each form.

Other data relating to materials were found necessary to be regularly reported and made part of the progress work, but space permits discussion here only of such charts as are felt to have more or less general application.

What were the estimated labor requirements for the project? Or, stated more precisely, how many workmen were to be necessary at different times and in different parts of the work during the construction, in order to complete the project on time? This was the first problem in the labor section of the progress work—a *labor program* had to be prepared.

Until the signing of the armistice, work at the Philadelphia Base was pushed on a war rush basis looking to the completion of the construction in eight months' time—a comprehensive schedule for a port terminal of its magnitude, under the conditions of labor supply which then existed. The work had been organized throughout on this war basis, administrative body and construction equipment and facilities provided, and the whole weight of the three organizations in the field thrown into the effort to better even the schedule that had been set.

After the signing of the armistice, the war basis of utmost speed gave place logically to a peace basis of greatest economy. By governmental direction all overtime work with its accompanying bonus pay was immediately cut out; and schedules were rearranged. On this peace basis the work was carried through to completion, but with some curtailment of the extensiveness of the original plans.

A graphical chart of the Preliminary Labor Program on a war basis is given in Fig. 6. The curve of estimated number of men required is shown in broken line, and of actual number of men at work in solid line.

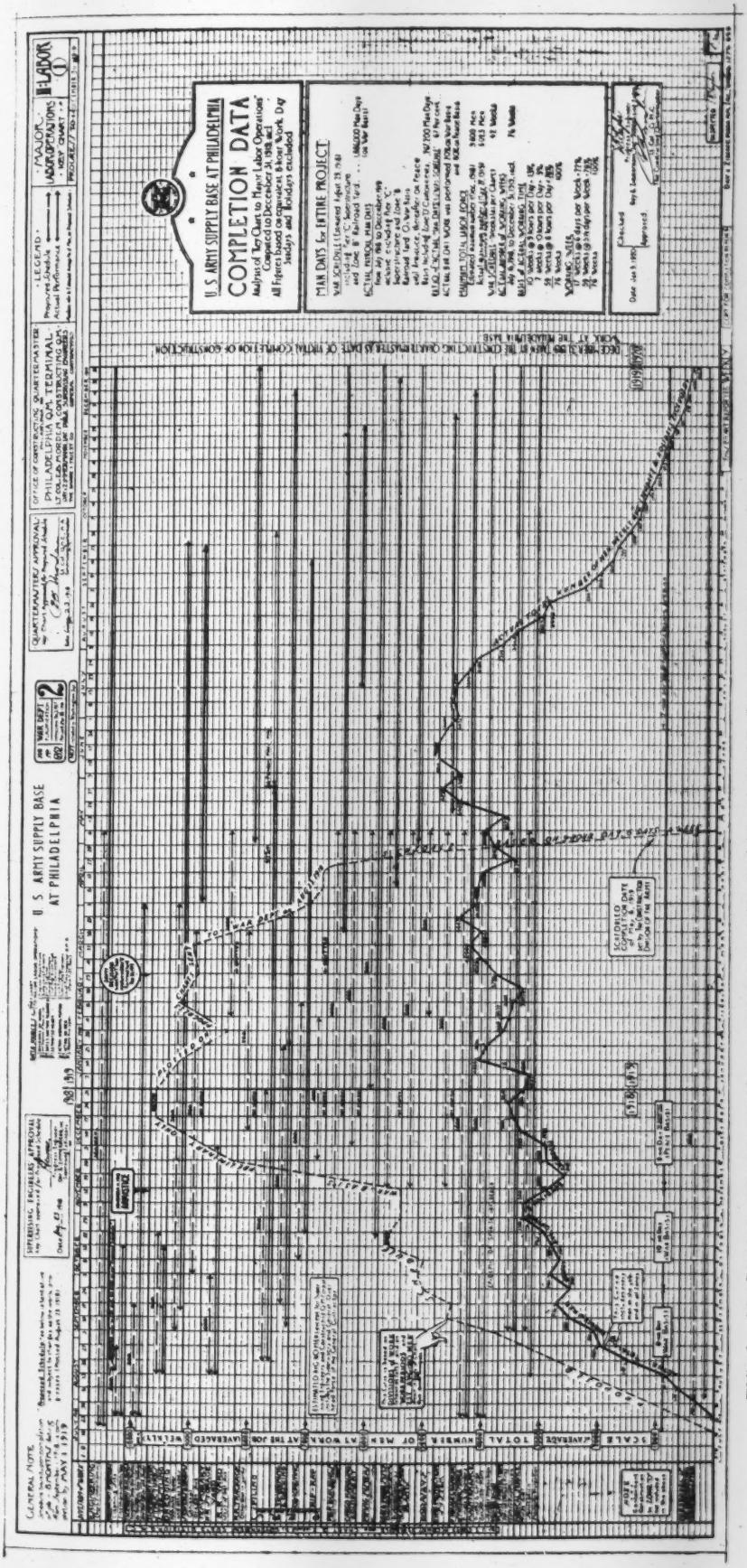


FIG. 6. GRAPHICAL CHART OF PRELIMINARY LABOR PROGRAM MADE BY PROGRESS DEPARTMENT ON PHILADELPHIA ARMY BASE

The conditions of labor scarcity during the wartime period are clearly indicated in the diagram by the amounts by which the actual number of men fall short of the required numbers. The shortage had its effect upon the general rate of progress, and consequently upon the program.

Referring still to Fig. 6, it should be explained that in the preparation of this preliminary program the main constructional operations first were analyzed and tabulated, and then their sequence, the expected dates of start and completion, and the estimated number of men required for each operation, were set down in conference between the Constructing Quartermaster, the general contractors and the supervising engineers. The results only of these analyses of labor requirements are given in the program chart.

In the various other charts in the labor section—and the generic diagram has shown how many there were—the data reported are of so varied natures and of such extensiveness that only the general plan can be explained here and one typical chart reproduced in Fig. 7, termed "Summary of Daily Labor Graphs."

The general plan was this: All labor at the Philadelphia Base was classified in a wage schedule which gave symbols (and rates) to some one hundred and twenty different classifications of wage earners. These one hundred and twenty classifications were grouped into the relatively few main divisions of labor on the work, namely: common labor, carpenters, dockbuilders, concrete workers, etc., and miscellaneous. Progress data were arranged to be reported in a separate chart for each group, together with the summary chart covering all groups and the supervisory and administrative forces in the three organizations in the field. In all of this, the use of the labor symbols, rather than the classifications themselves, speeded up the routine of what otherwise would have been a cumbersome reporting.

In the "Summary of Daily Labor Graphs," reproduced in Fig. 7, the general character will be seen of those Progress Charts which relate to labor, and examples will be found of the

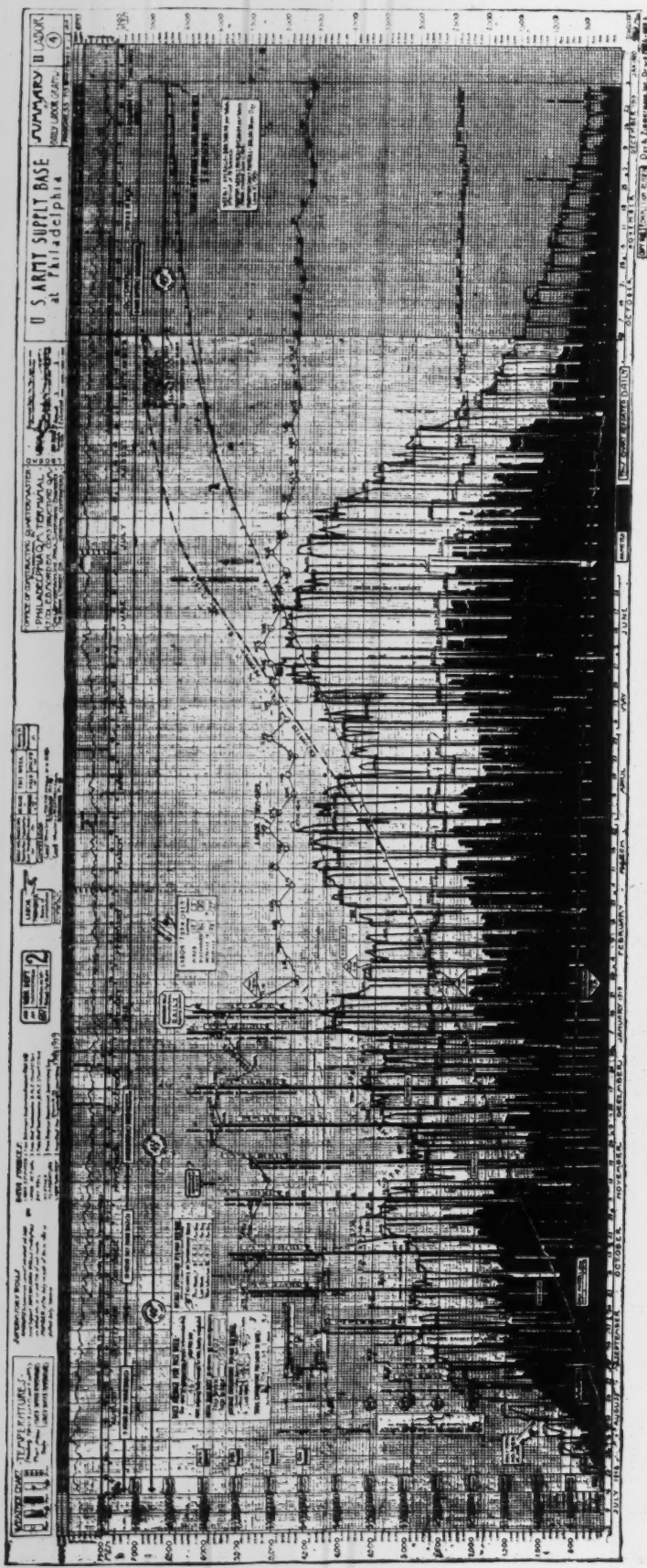


FIG. 7. SUMMARY OF DAILY LABOR GRAPHS AT THE PHILADELPHIA ARMY BASE

This Progress Chart, plotted daily but reported weekly, gave a summary of the labor supply in terms of the total number of men at work at the project each day (in heavy jagged line); gave the daily payroll (in vertical shaded ordinates); gave the total payroll expenditure to date (in light line curve, designated by dollar marks); gave the estimated total payroll expenditure necessary to complete the project (in heavy dash and dot line); gave the average expenditure per workman per day (in step by step curve, averaged weekly; for examples, see average of $7.36 pay per man per day for week of Oct. 22-29, 1918, and $5.44 pay per man per day, for week after signing of Armistice); gave the "Labor Turn-Over" for the job in terms of weekly percentage rate, averaged over all trades (in light jagged curve in upper half of chart); and finally, gave a record of daily weather and temperature conditions (shown along top of chart). In addition, certain averages and other data for the current week were shown statistically in the blocked out rectangles found at left-hand side of chart. Maximum figures are read from the chart as follows: Maximum number of men any date, 5,023 men on May 27, 1919; maximum daily payroll any date, $36,500 on June 10, 1919; maximum weekly "turn-over" rate, 28.1 per cent for week ended Nov. 26, 1918; maximum average expenditure per workman per day, $7.36 pay, for week ended Oct. 29, 1918. During the height of wartime construction, the chart shows that a half million dollars was expended about every 28 calendar days for labor payroll at the Philadelphia Base.

following data, graphically expressed:

Number of men a work—daily fluctuations and weekly averages. "Man days" for the week, and total "man days" to date of report. Daily payroll. Labor expenditures to date (cumulative totals). Estimated total labor expenditures, to end of job. Average labor expenditures per workman per day (averaged weekly). Weekly percentage rate of "turn-over" (or replacement in working force). Number of men in administrative and general supervisory forces (daily). Administrative and general supervisory payrolls expressed as percentage of total payroll (weekly and cumulative computations). Fluctuations in basic labor rate. Normal workday (8-hour day, 9-hour day, etc.). Weather and temperatures, as affecting the work performed by labor.

Not shown in this particular chart, but of more than passing interest, is the curve of weekly "turn-over" for common labor, which on one occasion reached the surprising value of 99.2 per cent for the week. In other words, there was the equivalent of nearly one hundred per cent replacement of workers under the classification of common labor, during a period of six working days. Nor was any strike on.

"Bonus" hours, as is well understood, are those hours which are credited to a worker because of overtime that he has made, and are granted according to the overtime rate. The overtime situation at the Philadelphia Base was closely watched and was made the subject of a Progress Chart, although not reproduced here. When overtime work was eliminated, or practically eliminated, directly after the signing of the armistice, the dollars and cents paid because of "bonus" hours dropped from 17.9 per cent of the total payroll for the week preceding Nov 11, 1918, to *three-tenths of one per cent* for the week following! The war basis of utmost possible speed had been supplanted by the peace looking toward greatest possible economy.

Under the section, Administrative Charts, were included charts on the financial status of the project, on unit labor

costs of construction as compiled by the Government Costs Division maintained in the field, and on the status of routine work in the administrative offices, such as relating to traffic and transportation, claims, equipment, purchases, accounting, etc. The scheme of reporting data from these sources to the Progress Department was that already described. The charts included in this section are not reproduced here, but gave the means of knowing readily from week to week what the project was costing and whether the various administrative offices were up in their work.

In the above have been described the Materials Charts, the Labor Charts and a reference made to the Administrative Charts at the Philadelphia Base, and some explanation given of the mechanism by means of which the Progress Department was run. In Part II, to appear in a succeeding issue, will be described the charts and schedules which had to do with physical progress of construction and with the engineering features and data at this project.

A New Salary Schedule Urged for Engineers in Federal Service

A JOINT Congressional Commission, known as the Reclassification Commission, has been for more than a year investigating the readjustment of salaries of Federal Government employees of all classes and is to make a report this month. To protect the interests of engineers before this commission, an advisory committee, representing the various classes of engineers in Government service and also architects and naval architects, has been at work for some time and recently presented a brief summarizing its arguments for a material advance in the salaries of engineers in Federal service. Extracts from this brief follow:

SALARY SCHEDULE PROPOSED BY ADVISORY COMMITTEE FOR ENGINEERING SERVICES

Grade	Minimum	Maximum
Senior	$8,400	$12,000
Professional	5,820	7,920
Associate	4,260	5,460
Assistant	2,880	4,080
Junior	1,860	2,580
Aid	1,860	2,700
Junior Aid	1,320	1,680

The engineering services submit herewith a salary scale for application to all engineering services under the Government. This schedule represents the minimum which the general engineering services could endorse and it has been approved by unanimous vote of their representatives. If any lower schedule were proposed, it would become necessary for a number of the engineering services to ask for differentials, which if adopted would defeat one of the primary objects of the reclassification by establishing different schedules for similar responsibilities. Further, the adoption of a uniform scale throughout the engineering services will eliminate competition between different government bureaus for men of essentially the same qualifications.

A higher salary scale is necessary to attract competent men to the engineering services of the Government. Under present conditions it is not possible to secure a sufficient number of eligibles by Civil Service examinations from which to make selections for the engineering services in either the lower or the higher grades. It is improbable that there will be an early return to pre-war economic conditions; therefore the present dearth of eligibles for the higher positions will continue and tend to increase rather than decrease.

Turnover in the engineering service is of vastly greater importance than in other services, because of the greater length of time required to train men to perform the highly technical duties of their offices. One group of laborers can be exchanged for another with very little interruption of the work or reduction of efficiency. This is not possible in the case of the technical services, in which continuous service in a given connection is always accompanied by an increase of efficiency over a period of years.

We regard a reasonable turnover of perhaps 10% or so as desirable and perhaps essential to the maintenance of a healthy state in the services. The actual turnover which exists in the engineering services at the present time is, however, so far in excess of this healthy figure as to constitute a very grave situation. Many still remain in the service in the hope that the reclassification will bring about a revision of salaries that will meet the exigencies of the situation. Should this hope not be realized there is certain to be a very large exodus of the most competent men from the services within the coming year.

Five main lines of evidence are used to show salaries paid in the industries:

1. *Data Gathered by Reclassification Commission*—The Commission has gathered a considerable amount of data as to the salaries being paid in a number of industrial concerns located principally in the northeastern section of the country. This information has been summarized and used as one of the bases of our proposed salary scale. We understand, however, that this summary is subject to revision by the Commission. A composite scale showing the average salaries in all groups is given in Column 1 of Table I.

TABLE I. SALARY SCHEDULES PREPARED BY VARIOUS UTILITIES. SCALE PROPOSED BY ADVISORY COMMITTEE

	1	2	3	4	5	Maximum 6	Minimum 7	Est. Average 8	9
Senior	$8,400	$15,500	$8,910	$10,400	$10,600	$12,000	$8,400	$9,600	$10,760
Engineer	5,100	7,515	6,580	6,410	6,600	7,920	5,820	6,500	6,400
Associate	3,100	4,350	4,100	4,330	4,880	5,460	4,260	4,660	4,190
Assistant	2,350	3,130	3,590	2,770	3,400	4,080	2,880	3,280	3,050
Junior	1,800	2,320	2,320	1,960	2,470	2,580	1,860	2,100	2,135
Aid		1,600	1,880		1,960	2,700	1,860	2,140	
Junior Aid		1,170	1,740			1,680	1,320	1,440	

Column 1. Salary Schedule shown by Reclassification Commission Data.
Column 2. Salary Schedule shown by Engineers' Committee Data.
Column 3. Salary Schedule received by Government Engineers immediately after leaving service.
Column 4. Salary Schedule proposed by Engineering Institute of Canada.
Column 5. Composite salary schedule of representative concerns operating under the "Macy" scale.
Columns 6, 7 and 8. Base Salary Schedule proposed by Scientific and Technical Services.
Column 9. Composite Schedule, average of columns 1 to 5 inclusive.

NOTE: In computing the average salaries shown in column 8, we have uniformly added to the mimimum of each grade an amount equal to one-third of the range in that grade. Column 4 has similarly been reduced from specified minimum values by increasing each minimum by the same percentage as in the case of column 8.

2. *Data Gathered Directly from the Industries by this Committee*—In view of the fact that practically the entire country competes for the services of the government's engineering personnel, we have deemed it proper to gather additional data as to the salaries paid in other sections of the country. Definite salary schedules for substantially all grades of engineers were obtained directly from eleven large private concerns. These included several large public utility corporations, consulting engineering firms and one large manufacturing company. The names of these companies are given in Table II, together with schedules paid by each company. From these data a weighted average salary scale has been determined which is shown in Column 2 of Table I.

3. *Salaries Received by Engineers on Leaving the Government Service*—Data obtained by the Commission from the various bureaus showing salaries received by technical men on leaving the Government service were made available to the engineering committee. The data as supplied by the Commission were grouped by services and it was not possible in that form to interpret correctly its significance. We have accordingly regrouped and summarized it by grades in accordance with the Commission's proposed reclassification. A few additional cases known to the committee have been added to the senior grade only. Since these figures are the averages over a long period of years they are obviously too low to represent existing industrial salaries. This should be borne in mind in making comparisons. The salary scale thus prepared is given in Column 3 of Table I.

4. *Salary Schedules Proposed by the Engineering Institute of Canada*—The Engineering Institute of Canada has recently proposed standard classifications and salary scales for engineers. The schedule classifies engineers employed by railways, municipalities, industrial firms, large public utilities, and the public works department of Canada, and states the minimum salary which should be paid in each case. A composite scale representing the average compensation proposed for engineers equivalent in responsibility as measured by minimum experience requirements, to the grades proposed by the Reclassification Commission, has been prepared and is tabulated in Column 4 of Table I.

5. *Salary Schedule of the War Labor Adjustment Board*—In Column 5 appears a composite salary scale of three representative concerns operating under the "Macy" scale. The data for this shedule were collected by the committee, but it is understood that they are in substantial agreement with that collected by the Commission. It is believed that the Naval Architectural Service in the commercial field has more nearly reached post war stabilization than any other of the engineering services. For this reason special weight should be accorded this schedule.

Salary Schedule Proposed—In Columns 6, 7 and 8 of Table I is given the salary schedule proposed to the Commission by this committee. This schedule is the one referred to at the beginning of this brief and is proposed as a general schedule for all engineering services.

The data presented above affords substantial support to the proposed salary scale. Summarizing the data presented in Table I, it will be seen that the average proposed salary scale shown in Column 8 is somewhat above the salary scale shown in Column 1 compiled from industrial concerns. The salary schedule shown in Column 3, compiled from figures representing the salary received by technical men on leaving the Government service is in substantial agreement with the proposed scale. It should be taken into account, however, that these figures represent salaries received by men who have left the service during a long period of years and, in many cases, go back to the time when general salary schedules were much lower than those prevailing at the present time, so that this scale cannot be regarded as representing salaries equal to what men of the same qualifications could secure at the present time.

In case of the other two salary schedules, namely, those given in Columns 2, 4 and 5 of Table I, the figures are in general somewhat in excess of the base scale proposed by this committee. Individual figures range both above and below the proposed scale. A composite schedule comprising the average of the salaries shown for the professional grades in Columns 1 to 5 inclusive has been calculated and is shown in Column 9. This composite schedule is slightly in excess of the proposed schedule in some grades and below it in others, but on the whole there is substantial agreement between the two.

Professional salaries paid in the industries are now being revised upward. In order to form a proper judgment of the merits of the proposed salary scale it is necessary to take into account this upward trend. Statements made by large private employers of engineers show that the readjustment of engineering salaries to meet present economical conditions is just getting well under way and may be expected to continue for an indefinite period. Unless this is taken into account by the Commission in fixing a salary scale, such scale may become antiquated almost by the time it can be put into effect. Because of this fact any scale proposed now should be somewhat in excess of the average salaries paid in the industries.

The proposed scale is therefore substantially what is now required to place the Government's engineering services on a competitive basis. Should there occur further material increases in industrial salaries a differential would have to be added in order to maintain the necessary competitive relation. The proposed scale represents therefore the minimum that can logically be considered at the present time.

TABLE II. SALARY SCHEDULES IN FORCE IN ELEVEN PRIVATE ENGINEERING CONCERNS.

	1	2	3	4	5	6	7	8	9	10	11
1	$22,000	$30,000	.....	.....	$12,500	$10,000	$15,000	$20,000	$10,000	$12,000	$8,000
2	8,100	3,700	$4,800	$9,000	8,750	8,000	6,000	15,000	5,200	6,000	.....
3	3,750	3,180	3,300	5,400	6,000	5,000	4,500	4,000	3,700	4,300	4,800
4	.....	2,150	2,265	3,800	3,900	3,500	3,200	3,300	2,560	3,350	3,300
5	2,700	1,690	1,980	2,400	2,700	2,700	1,950	2,400	2,400	.....	.....
6	1,250	1,280	1,650	1,800	2,000	1,800	.....	1,500	1,500	.....	.....
7	.....	900	1,440	1,200	1,300	1,200	1,200	1,200	920	.....	.....

The schedules shown above were obtained from the following firms. We are not free to state which scale applies to each firm: Great Western Power Co.; Southern California Edison Co.; Westinghouse Electric and Mfg. Co.; J. G. White & Co.; Hugh L. Cooper & Co.; Sanderson & Porter; Dwight P. Robinson, Inc.; a large New York structural company; three of the country's largest shipyards.

Decision Favors Railroad in Land Valuation Case

Supreme Court Sustains Kansas City Southern in Action Against Commission To Find Costs of Acquisition

THE Supreme Court of the United States, on Dec. 8, handed down a decision favoring the railroad company in the mandamus action of the Kansas City Southern R.R. to compel the Interstate Commerce Commission to admit evidence in proof of costs of acquisition for determining land values, in connection with the provisions of the Valuation Act, as cited below in the decision. The court not only ordered such admission of evidence, but directed the Commission to carry out the commands of Congress as embodied in the Act, particularly as regards finding the cost of reproduction and, separately, cost of acquisition.

The opinion of the court, which was delivered by Mr. Justice White, is printed below in full:

The Act of Congress of March 1, 1913 (37 Stat. 701), amending the "Act to regulate commerce," imposed the duty upon the Interstate Commerce Commission (section 19a) to "investigate, ascertain, and report the value of all property owned or used by every common carrier subject to the provisions of this Act." Specifying the steps to be taken in the performance of the general duties thus imposed, the same section commanded as follows:

"First. In such investigation said Commission shall ascertain and report in detail as to each piece of property owned or used by said carrier for its purposes as a common carrier . . . the cost of reproduction new, the cost or reproduction less depreciation, and an analysis of the methods by which these several costs are obtained and the reasons for their differences, if any . . .

"Second. Such investigation and report shall state in detail and separately from improvements the original cost of all lands, rights of way, and terminals owned or used for the purposes of a common carrier, and ascertained as of the day of dedication to public use, and the present value of the same, and separately the original and present cost of condemnation and damages or of purchase in excess of such original cost or present value.

* * * * * * *

"Fifth. . . . (8th par.) Whenever the Commission shall have completed the tentative valuation of the property of any common carrier, as herein directed, and before such valuation shall become final, the Commission shall give notice by registered letter to the said carrier, . . . stating the valuation placed upon the several classes of property of said carrier, and shall allow thirty days in which to file a protest of the same with the Commission. . . .

"If notice of protest is filed the Commission shall fix a time for hearing the same, and shall proceed as promptly as may be to hear and consider any matter relative and material thereto . . . All final valuations by the commission and the classification thereof shall be published and shall be prima facie evidence of the value of the property in all proceedings under the Act to regulate commerce as of the date of the fixing thereof, and in all judicial proceedings for the enforcement of the Act approved February 4th, 1887, commonly known as 'the Act to regulate commerce,' and the various Acts amendatory thereof, and in all judicial proceedings brought to enjoin, set aside, annul or suspend, in whole or in part, any order of the Interstate Commerce Commission."

Pursuant to these requirements the Commission proceeded to investigate and report the value of the property of the Kansas City Southern Railway Company. Upon completing a tentative valuation, the Commission gave the notice required by the statute to the Railway Company, which thereupon filed a protest against such valuation on the ground that in making it the Commission had failed to consider and include the "present cost of condemnation and damages or of purchase in excess of such original cost or present value." Upon the subject of the protest, the Railway Company took a large amount of testimony and much was also taken by the Commission, both parties having incurred considerable expense in the matter.

Pending this situation, in order that the excessive expense of taking each individual parcel and showing what it would cost to acquire it or a right of way over it by purchase or condemnation might be avoided, an agreement was entered into between the Director of the Bureau of Valuation of the Commission, C. A. Prouty, and the Railway Company, that in the event the Commission should decide that evidence upon the cost of acquiring land by purchase or condemnation would be received by it, the Bureau of Valuation would recommend to the Commission the percentage or multiplier of the naked value of the land, to be used for the purpose of reaching the railway cost of acquiring the same.

At that time there was also pending a protest concerning a tentative valuation made by the Commission as to the property of the Texas Midland Railroad Company, raising the same question as to error committed in failing to carry out the provisions of the statute concerning the present cost of condemnation, etc., in which case the Commission overruled the protest, holding that the provision of the statute in question was not susceptible of being enforced or acted upon for reasons stated by the Commission in part as follows (I. C. C. Val. Rep. 1, p. 54 *et seq.*):

"However, the direction in paragraph 'Second' for the ascertainment of the present cost of condemnation and damages or of purchase in effect calls for a finding as to the cost of reproduction of these lands. Must this be done, and can this be done? It seems elementary that the cost of reproduction can be estimated only by assuming that the thing in question is to be produced again, and that if it is to be produced again, it is to be taken as not existent. It seems sophistry to contend that the lands of the railroad can be produced again at a cost to the railroad without first making the assumption that they are no longer lands of the railroad; and this necessary assumption carries with it the mental obliteration of the railroad itself.

"Considerable testimony was produced to the effect that in the acquisition of a railroad right of way it is necessary for the carrier to pay sums in excess of the value of the land if measured by the present or market value of similar contiguous lands, and this because of the elements which have been enumerated and embraced in the protest, such as cost of acquisition, damages to the severed property, cost of buildings and other improvements, accrued taxes and various incidental rights.

* * * * * * *

"We are unable to distinguish between what is suggested by the carrier in this record and nominally required by the act and what was condemned by the court (in the *Minnesota Rate Cases*) as beyond the possibility of rational determination; nor is there any essential difference in the actual methods there employed and those now urged upon us. Before we can report figures as ascertained, we must have a reasonable foundation for our estimate, and when, as here, if the estimate can be made only upon inadmissible assumptions, and upon impossible hypotheses, such as those pointed out by the Supreme Court in the opinion quoted, our duty to abstain from reporting as an ascertained fact that which is incapable of rational ascertainment, is clear.

* * * * * * *

"Because of the impossibility of making the self-contradictory assumptions which the theory requires when applied to the carrier's lands, we are unable to report the reproduction cost of such lands or its equivalent, the present cost of acquisition and damages, or of purchase in excess of present value. The present value of lands as found by us appears in the final valuation, appended hereto."

Applying the ruling thus made to the protest which was pending in this case, the Commission gave notice to the Railway that the agreement made with the Director of the Bureau of Valuation concerning the method of proof would be treated as not further operative; and thereafter when an offer was made by the Railway before an examiner of the Commission of further testimony concerning the subject in hand, it was excluded because in conflict with the ruling announced in the *Midland* case. The Commission sustained this action of the examiner on the ground that that officer had rightly held that the ruling in the *Midland* case was controlling; and the Commission therefore decided that no further testimony on the particular subject would

be heard in this case, and that it would make no report concerning that subject.

This suit was then brought to obtain a mandamus to compel the Commission to hear the proof and act upon it under the statute. The amended petition, after reciting the facts as we have outlined them and making the appropriate formal averments to justify resort to mandamus, alleged:

"That the refusal of respondent to investigate and find such present cost of condemnation and damages or of purchase in excess of original cost or present value of relator's lands will result in great wrong and injury to relator; by way of illustration, such refusal will result in a finding by respondent of a value of but $60,000 with respect to parcels of land acquired by relator by judicial award in condemnation proceedings during four years immediately preceding such valuation at an actual cost to relator of $180,000; and in the aggregate will result in a finding with respect to said lands at least $5,000,000 less than the value so directed by the Act of Congress above mentioned to be found."

It was further averred, with considerable elaboration, that the petitioner stood ready to produce proof to meet the requirements of the statute which was neither speculative nor impossible to be acted upon, since it would conform to the character of proof usually received in judicial proceedings involving the exercise of eminent domain.

The Commission in its answer, either stating or conceding the history of the case as we have recited it, and summarily reiterating the grounds for the refusal by the Commission to receive the proof or report concerning it, challenged the right to the relief sought. A demurrer to the answer as stating no defense was overruled by the trial court, which denied relief without opinion. In the Court of Appeals, two judges sitting, the judgment of the trial court was affirmed by a divided court, also without opinion, and the case is here on writ of error to review that judgment.

It is obvious from the statement we have made, as well as from the character of the remedy invoked, mandamus, that we are required to decide, not a controversy growing out of duty performed under the statute, but on solely involving an alleged refusal to discharge duties which the statute exacts. Admonishing, as this does, that the issue before us is confined to a consideration of the face of the statute and the non-action of the Commission in a matter purely ministerial, it serves also to furnish a ready solution of the question to be decided, since it brings out in bold contrast the direct and express command of the statute to the Commission, to act concerning the subject in hand, and the Commission's unequivocal refusal to obey such command.

It is true that the Commission held that its non-action was caused by the fact that the command of the statute involved a consideration by it of matters "beyond the possibility of rational determination," and called for "inadmissible assumptions," and the indulging in "impossible hypotheses" as to subjects "incapable of rational ascertainment," and that such conclusions were the necessary consequence of the *Minnesota Rate Cases*. (230 U. S., 352.)

We are of opinion, however, that, considering the face of the statue and the reasoning of the Commission, it results that the conclusion of the Commission was erroneous, an error which was exclusively caused by a mistaken conception by the Commission of its relation to the subject, resulting in an unconscious disregard on its part of the power of Congress and an unwitting assumption by the Commission of authority which it did not possess. And the significance which the Commission attributed to the ruling in the *Minnesota Rate Cases*, even upon the assumption that its view of the ruling in those cases was not a mistaken one, but illustrates in a different form the disregard of the power of Congress which we have just pointed out, since, as Congress indisputably had the authority to impose upon the Commission the duty in question, it is impossible to conceive how the *Minnesota Rate* ruling could furnish ground for refusing to carry out the commands of Congress, the cogency of which consideration is made particularly manifest when it is borne in mind that the *Minnesota Rates Cases* were decided prior to the passage of the Act in question.

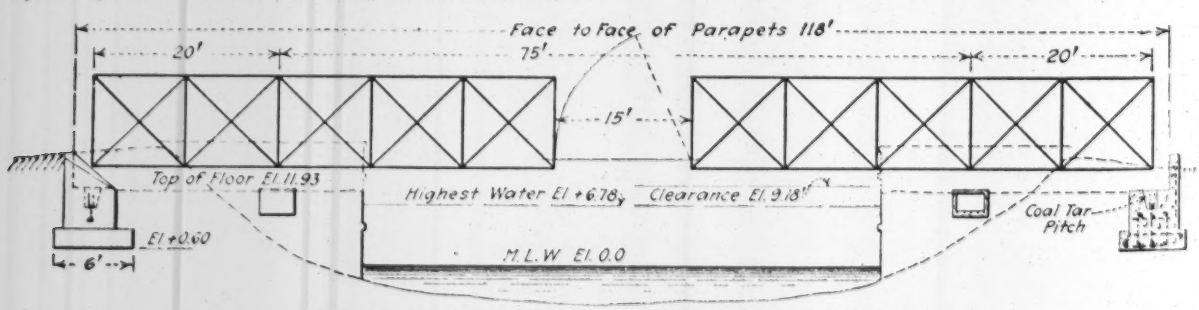
Finally, even if it be further conceded that the subject-matter of the valuations in question which the Act of Congress expressly directed to be made necessarily opened a wide range of proof and called for the exercise of close scrutiny and of scrupulous analysis in its consideration and application, such assumption, we are of opinion, affords no basis for refusing to enforce the Act of Congress, or what is equivalent thereto, of exerting the general power which the Act of Congress gave, and at the same time disregarding the essential condition imposed by Congress upon its exercise.

The judgment of the Court of Appeals is therefore reversed with directions to reverse that of the Supreme Court, and direct the Supreme Court to grant a writ of mandamus in conformity with this opinion.

[Many current newspaper reports following the decision apparently led to widespread belief that it ordered recognition of present prices in the basis of value to be used under the rate-rule of the new Interstate Commerce Law. Editorial comment appears on p. 552.—Editor.]

Bascule Lift Span Between Cantilevers

FOR reasons of simplicity and economy, a remarkable type of structure was adopted when it became necessary to build a bridge with draw span across a narrow strait between the Islands of Bohol and Panglao, Philippine Islands, last year. Frequent passage of sailing craft through the strait made it necessary to provide the movable span. The Bureau of Public Works, Philippine Islands, designed the structure of timber on account of the excessive cost of steel. "A unique scheme was conceived for providing the required opening," states C. E. Gordon, chief designing engineer, in the *Quarterly Bulletin, Bureau of Public Works*, "by throwing two timber cantilever spans out from each bank and completing the connection by a hinged counterweighted lift section. The lift section is provided with a hand-power windlass, and the span can be opened at any time by the two attendants." The sketch herewith pictures the arrangement. Each arm of the bridge cantilevers 20 ft. to the bascule opening.

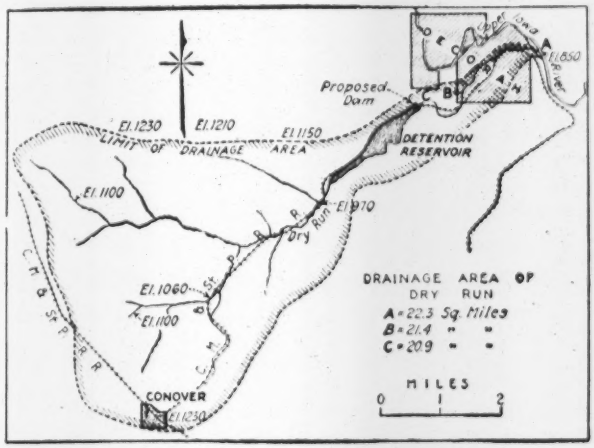


TIMBER BRIDGE WITH DRAWSPAN BETWEEN CANTILEVERS

Flood-Protection Reservoir for Decorah, Iowa

Dam and Retarding Basin Recommended for Flashy Stream Which Floods City of 4200— Storm Records

APPLICATION of the detention-basin system of flood control for the protection of a small city has been recommended in a report on flood relief for Decorah, Iowa, made by Alvord & Burdick, consulting engineers, Chicago. The present population is about 4200, but as the flooded area contains 33% of the population the condition is serious, while the extent of the flood damage is considered by the engineers to justify an expenditure as high as $250,000 for protection, although their proposed works would cost only $120,000.



PLAN OF FLOOD-PROTECTION RESERVOIR AT DECORAH, IOWA

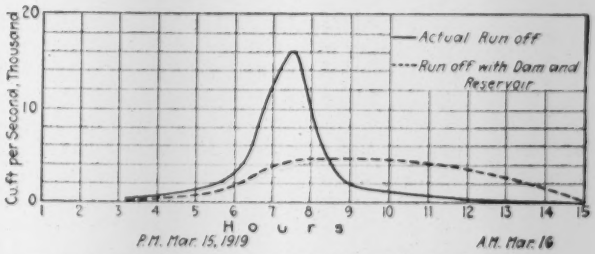
A small stream known as Dry Run, flowing diagonally across the residence district to the Upper Iowa River, has a steep slope of 30 to 50 ft. per mile, largely in rock, and normally it carries a small flow or is dry. Its drainage area is funnel-shaped, with the neck in the city. It covers only 20 square miles, and is characterized by steep slopes and impervious surfaces, with numerous ravines, the average surface slope being about 40 ft. per mile. Thus the rainfall is delivered rapidly to the creek, even when the soil is not frozen or saturated, so that the run-off follows close after the rainfall. Even floodwater confined within the banks has a velocity of 30 to 50 ft. per minute in a channel having a cross-section of not over 500 square feet. Such a condition tends to result in severe scouring of the channel.

The great flows have resulted from short storms of high intensity, with the flood crest following the rainfall at an interval of only about an hour. In 1902, 1916 and 1919 the stream flooded an area several hundred feet in width, causing much damage and some loss of life. These three floods were of about equal intensity, with a peak run-off of about 16,000 cubic feet per second, but on the basis of other storms in this locality it is thought reasonable to expect and provide for future run-offs 60% greater, or about 26,000 cubic feet per second.

Four principal methods of relief were considered: (1) Raising the houses above flood level; (2) building a dam across Dry Run and an outfall tunnel to the river; (3) enlarging and straightening the channel to carry off the floodwater, and (4) building a dam to form a storage or detention basin which will hold back the peak flow and will have outlets giving a gradual discharge after the storm. High cost or inadequate protection led to the elimination of the first three methods.

According to the general plan recommended, an earth dam would be built across the stream about two miles above the city, with concrete conduits having an aggregate discharge capacity of 5000 cubic feet per second. Its crest would be 40 ft. above the bed of the creek, with a spillway 100 ft. long at an elevation of 30 ft. This would provide for floods of the intensity so far experienced, without any overflow of the existing channel. It would give a 2½-ft. freeboard even for the heavier storm considered as a possibility, although during such a storm the flow below the dam would exceed the capacity of the present channel. Diversion of the Chicago, Milwaukee & St. Paul R.R. would be necessary for about one-half mile on each side of the dam.

Storms of high intensity rather than of long duration cause the floods at Decorah. Rainfall in this district in May averages 4½ in., but in May, 1902, it reached 11.62 in., with a record of 3.35 in. for May 21, the day of the flood. As the soil had been saturated by previous rains, the run-off was unusually rapid and destructive. On June 1, 1916, a storm from 5:30 to 7 p.m. gave a total rainfall of 3.21 in., with flood results approximately the same as in 1902. On Mar. 15, 1919, the main storm lasted only 45 min. but gave a total precipitation of 2.18 in. The stream was out of its banks for only about two hours, while in eight hours the run-off had returned to normal conditions. The maximum rate of flow is computed to have been 16,000 cubic feet per second. In the accompanying diagram are shown the rate of flow for this storm and its probable rate if the proposed dam had existed. This shows that the peak of a two-hour flow outside the banks would have been spread over several hours of low flow confined within the channel of the creek.


Cu ft per Second, Thousand
20
10
0
Actual Run off
Run off with Dam and Reservoir
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Hours
P.M. Mar. 15, 1919
A.M. Mar. 16

STORM RUN-OFF WITH AND WITHOUT RETARDING RESERVOIR

Heavy rains of long duration are the conditions on most streams where flood-protection works have been necessary, the nearest approach to the Decorah condition, according to the report, having been the Mill Creek flood at Erie, Penn., Aug. 3, 1915. This came about five hours after a four-hour storm giving a total rainfall of 4.31 in. on a drainage area of 13 square miles. Reference is made by the report, however, to the storm of Aug. 8, 1906, at Madison, Wis., with a rainfall of 3.6 in. in one hour and 5 in. in two hours. As this is in the same storm belt as Decorah, it has a direct bearing upon the possibilities of future storms at that place, and consequently upon the plans for protection works.

After the storm of March, 1919, the Decorah city

authorities engaged Alvord & Burdick, consulting engineers, Chicago, to investigate and report upon flood protection works. Surveys in connection with this were made by A. R. Coffeen, city engineer. The report of Alvord & Burdick was submitted in September, and from it the above information has been compiled. The engineer's estimate includes the following main items: Earth dam, $42,000; outlets and drift barriers, $25,000; railway relocation, $20,000; land, $2500; channel improvement and bridge changes, $15,240; total, $120,000.

Experiences in Water-Waste Reduction

AN experience meeting devoted to water-waste reduction was held on Feb. 18 by the New York Section of the American Water Works Association. D. W. French, superintendent Hackensack Water Co., Hoboken, N. J., outlined the successful use of the aquaphone in detecting leaks in mains and services. In a district now having 116 mi. of water main the water accounted for twenty years ago was 55 per cent of the total supplied to the section, whereas in 1919 it was 74 per cent.

George C. Andrews, water commissioner, Buffalo, N. Y., said that in a two-year campaign against water waste the average daily pumpage had been reduced from 250,000,000 to 200,000,000 gal. a day, and the daily per capita consumption from 330 to 260 gal. A proposition to install a larger number of meters was turned down by the governing authorities of the city two years ago, but within a few weeks an appropriation for 10,000 meters was voted without a dissenting vote.

A. W. Cuddeback, engineer and superintendent, Passaic Water Co., Paterson, N. J., said that following the extreme cold weather and the high consumption of the winter of 1917 the use of meters was increased. To this is attributed the fact that the winter consumption peak this year is lower than it has been for five years past. This is in the Paterson district where 85 per cent of the services are now metered and where the consumption in 1919 averaged 61 gal. per capita per day—but this does not include 6,000,000 gal. of raw water daily supplied to six or seven silk mills. In the Montclair district some twelve years ago, with 100 per cent of the services metered, only 45 per cent of the water was accounted for, but the meters had not been very well looked after. Since then by better inspection of meters and by the use of the aquaphone the accounted-for water has been increased to 68 per cent.

William W. Brush, deputy chief engineer, Department of Water Supply, New York City, stated that water waste control in New York had been spotty. The Board of Aldermen has the say as to whether meters shall be installed on anything but business houses. For two or three years past no effort has been made to get the consent of the Board to the extension of the meter system. Mr. Brush was of the opinion that the authorities of New York City could make or permit water consumption to be whatever they chose from a daily per capita average of 100 gal. Continuing the story as to attempts at water waste reduction in New York, George B. Nelson, assistant engineer, said that for the last few years it had been necessary to restrict water-waste reduction work to emergency measures, such as dealing with obvious leaks. About 25 per cent of the 390,000 taps are metered and about 25 per cent of the consumption. The latter leaves some 400,000,000 gal. of water consumption a day unguarded.

Value of Top Soil as Base for Modern Highways

Recommendations Made That Earth's Crust Be Unmolested and That Side Ditching Be Avoided

By D. S. Humphrey
Member Highway Advisory Board of Ohio

[Mr. Humphrey's recommendations will be read with interest by that part of the engineering profession most concerned with highway work. What he advocates is more or less startling; it should form the basis of lively discussion.—Editor.]

INFORMATION necessary for successful road building under present conditions cannot be found in any road literature. In my investigations I have found that a very limited portion of the top soil, the crust of the earth, has been preparing, through the ages, a road bed—a road foundation. Wherever possible, this natural foundation must be conserved. This crust contains the centuries' accumulation of decayed organic matter. I want to state emphatically that this crust is the salvation of most soils used either for dirt roads or as foundations for artificial surfaces. Besides the decayed organic matter, which has great binding qualities, the top earth nearly always contains a large per cent of sand, gravel and other inorganic minerals. It is unquestionably best for the wearing surface of earth roads and is of incalculable value in the foundation of any artificial surface. Road builders, ignorant of its value, and in an effort to avoid all grades, ofttimes, and for no conceivable reason, have failed to account for this natural foundation, this material right at hand.

Don't Remove Top Soil

The almost universal practice has been and is, to remove this crust by grading it off, even when the ground is comparatively level. This practice has resulted, not only in Ohio, but all over the United States, and especially in sections subjected to heavy frost, in putting the improved surface on jelly-like subsoils that have of themselves no carrying qualities. The roadbeds are placed so low in nearly all cases that the water cannot be drained off through the natural channels—which is vitally important—but must be carried long distances along the road to soak and undermine it.

If there is one thing more than another that I have full conviction of, it is that *it must be the universal policy never to run water in open ditches along the roadside, where it is possible to drain into the fields.*

Although much research has been done in analyzing and classifying soils for agricultural and manufacturing purposes, and volumes have been written, yet no one has ever classified soils in relation to road building. I believe if a thorough research is made and the results put into practical form for road builders' use, it will eliminate the most of the difficulties now experienced in making roads that will live.

All the works that we have seen on highway construction advise getting rid of soils containing organic matter, while any observing person can find abundant proof that any road, anywhere, holds best where the top soil has been utilized for a bed. The most substantial roads we have in Ohio are on the Black Lands in the northwestern section of the state, where there is a very large proportion of decayed vegetable matter in the soil.

On Main Market Road No. 1, running across the northern edge of Ohio, a common earth road in a tenacious clay section, improved several years previously by the application of 6 to 8 in. of limestone 8 or 9 ft. wide, without grading the old road off, was able to support the heavily loaded Government war truck trains. These roads, I believe, cost around $3,000 a mile. They needed very little repair, while exactly the same traffic was very destructive to roads that cost ten to twenty times as much, where grading had removed all of the old road bed, an unnecessary procedure since through this section the land is just rolling enough for practical drainage.

Experience Justifies Theories

A 12-ft. concrete road near Norwalk, only a little more than 4 in. thick, down 8 or 9 yr., held up under this traffic because it was put on top of the old earth road. If a few inches of the old roadbed had been graded off, a bad clay soil would have ruined the chance for its holding up. The first 6 to 12 in. of the surface is most valuable, but without doubt this bearing up quality usually extends deeper—on rises less than on lower ground. A very light cut in a rise often gets into the most unstable clay or quicksand. "Grading down to a good foundation" is absolutely erroneous reasoning.

Clay is really a fluid—has no stability as substance. When the least bit moist it is always moving, slipping and flattening out. Cuts in clay, together with deep side ditches, afford the ideal conditions of instability. On the Cleveland-Akron Road, thick non-skid chains on heavily loaded trucks helped jar and churn the clay into a soft jelly-like mass. The inadequate improved surface could not withstand the strain. A $40,000 per mile stretch in Cuyahoga Co., of 8-in. and 7-in. concrete base, and 2-in. bituminous top 18 ft. wide, with brick gutters 5 ft. from the curb and tile drains under the brick surface gutters, broke up with this pounding traffic. The road had been completed only six months. It is very significant that it did not break where there was very little or no grading.

During the war when truck traffic was general in Ohio, and when the roads were failing, I took nearly 300 photographs across the State, and they certainly testify to all that I have said.

The State Maintenance Department has expended over $200,000 on the Cleveland-Akron Road. This road has received the great war through traffic, also the enormous local hauling between Cleveland and Akron, and in every case where the pavement has given out and has been reconstructed the old roadbed had been removed—cuts through these very moderate grades had removed all the top soil. In places where the improved surface was put on the old earth roadbed, the pavement still stands.

Drainage

If possible, the finished surface of an improved road should be about on a level with, or a little above, the surrounding land. This allows drainage into all the natural water courses without deep side ditches. In the near future I hope to see sewer pipe laid in all cases where deep side drainage seems to be necessary, and all dangerous conditions done away with.

Draining the water away from the road is logical drainage. You can't get the water away from the road too soon for the good of the road. Deep side ditches are a menace to travel and mean draining the farms into the roads and running the water on by natural water courses. In cities, pavements are set low with curbing backed up by sidewalks or lawns which hold pavements in place, all the water being drawn into sewers under the streets. The exact opposite must be the rule for country roads. Follow the contour of the road, if possible. Keep the roads on top of the ground; employ very shallow side ditches; and keep every natural water course open.

The berms will be stable if the ditches are shallow. The report of the maintenance department shows that it costs much more to maintain the berms of the state roads of Ohio than it does to keep the improved surfaces in repair. Deep side ditches, carrying the water along the roads, and unfertile soil from deep ditches used in the berms, cause all the trouble. The berms should be grassed over—fertile soil is needed.

Earth Road Experience

For more than 30 yr. my father and I maintained an earth road alongside our big farm in Huron Co., during which time nothing was ever done to the surface except to keep the road smooth and see that every natural water course was kept open away from the road. This road was something over 2 mi. in length, in a very level clay country. There were almost no side ditches, and a good crop of hay was cut every year on each side of the road. In order to avoid carrying the water alongside the road, there were many small culverts across the road within this section. The surface of this road became absolutely flat in cross section, and the grass edges so high that the water could not leave the road at the sides, but had to follow lengthwise until reaching the low spots in the road where it was immediately ditched into the fields. There were no grades of more than 1 to 2 per cent in this 2 mi. of roads. The road surface was quite wide, averaging perhaps 24 ft. After every considerable rain storm, we dragged the road. This road was passable more than 10 mo. of the year and it was a road that received more traffic than many roads that were bad all the time, and concerning which practice had prescribed grading and side ditching. It will be borne in mind that this road bed contained only the top-soil. In the early history of this road it had been corduroyed, because it was so difficult to drain.

If we persist in making deep side ditches and disregarding soil conditions we may expect everything but good results. I seem to get the impression that road makers think that engineering means doing some physical thing. Is it not possible that letting things alone may mean good engineering? The demand and necessity for passable roads is so great that many old macadam and gravel roads should be maintained. In order to bring roads to railroad grades I have seen good stone and gravel roads steam shoveled up and hauled to the dump—a high cost road made on an unstable surface that will not hold. In this connection, it must be borne in mind that it often takes 5 to 8 yr. to prove whether roads will stand our modern traffic. Rarely do roads give out soon after completion.

Our chief engineer Mr. Bruning has stated that he has mailed a letter to all resident and district engineers to abandon the railroad grading idea. I sincerely hope that this instruction will be heeded, and also that a change will be brought about in handling soils and drainage, along the lines that have been outlined in this paper.

Passengers and Freight Carried More Cheaply by Motor Transport Than by Railway

Good Roads and Favorable Climate in California Are Being Capitalized by Large Numbers of Stage Companies Operating Interurban Lines—Joint Terminal in Los Angeles

By Kenneth Q. Volk
Associated with J. B. Lippincott, Consulting Engineer, Los Angeles

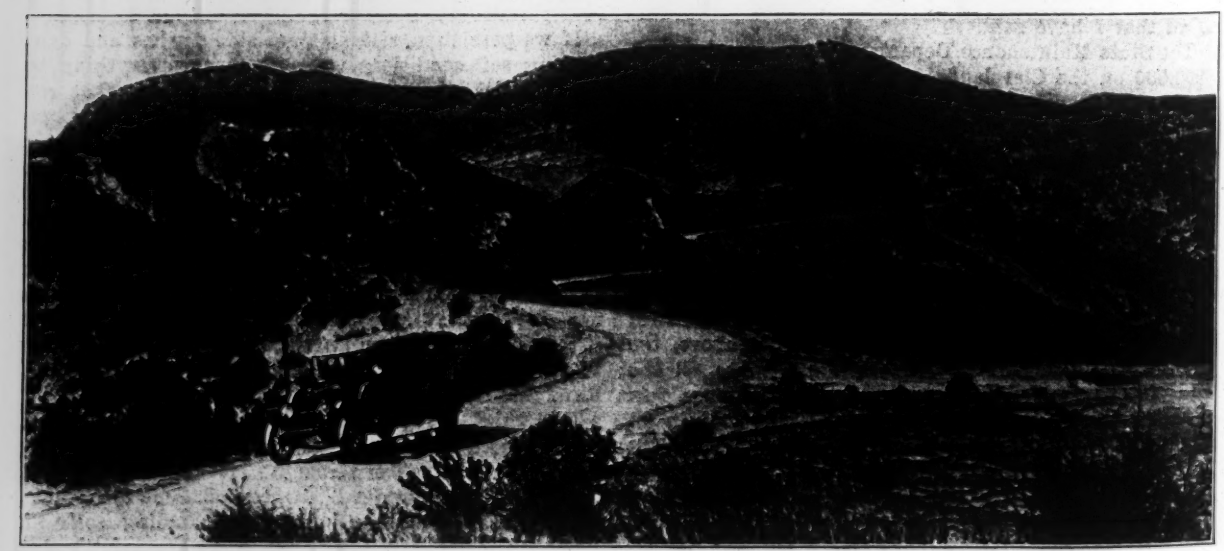
During the past few years there has been such a marked increase in the number of people and the volume of freight carried by automobile in southern California that companies organized for that purpose have been able to offer passenger and freight rates lower than competing steam and electric railways. The increase can be attributed to favorable climatic and topographic conditions, backed by the splendid system of paved roads. It is possible for automobiles to operate every day in the year and to cover the same distances during wet and dry weather, although in southern California the wet season is of short duration. Hundreds of towns, not accessible by rail, have been reached by a network of paved highways, and have been put in touch with centers of industry and commerce by freight and passenger motor lines.

The question of competition between interurban stages and steam and electric lines is serious. All interurban stages are giving more frequent and quicker service at a lower rate than the steam and electric lines. There is considerable difference between the rates charged for one-way and round-trip fares in the cases of the buses and the electric lines. This difference also applies to 30-ride books. The manager of one transportation company stated that his organization was carrying from one of the smaller cities six passengers to the electric company's one.

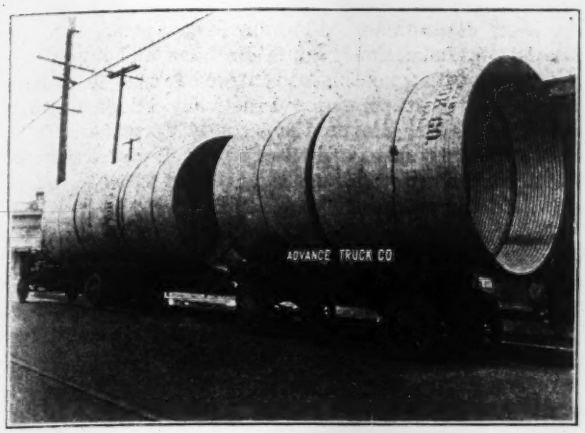
The larger bus companies maintain their own waiting rooms for passengers. A number of stage companies united in the building of a joint terminal in the heart of the business district of Los Angeles for the accommodation of their patrons. The managers of various interurban stages state that their cars are operating continuously with an average load factor of from 75 to 85 per cent. The Eldorado Stage Co., operating between Los Angeles and Bakersfield during 1918, transported 36,505 passengers. The United Stages, between Los Angeles and Santa Barbara for the same period, carried 23,286 passengers. The Valley Stage Line to Anaheim, carried 112,187 passengers.

The California State Railroad Commission, under Chap. 213 of the Laws of 1917, was given jurisdiction over motor vehicles engaged in the transportation of persons and property for compensation over the public highways in the state between fixed termini, one or both of which are outside the incorporated limits of a city or town. The Railroad Commission has jurisdiction to fix rates, classifications and rules, and to regulate the accounts, service and safety of such transportation companies, which jurisdiction shall supersede any conflicting jurisdiction exercised by municipal or county authorities.

This act, amended in 1919, further provides that anyone desiring to engage in stage or truck transportation between fixed termini must obtain a certificate of public convenience and necessity from the Railroad Commission. The applicant, in order to secure such a certificate, must state the places and intermediate points between which he desires to operate, the proposed fares to be charged for service, rules and regulations covering service, copy of his proposed time schedule, a description of the equipment to be operated, name of the company and the various officials interested in it, the name of the stage or trucking line, steam railways and electric railways operating between the points which he proposes to serve, and the conditions on which the applicant relies as justification for being granted a certificate of public convenience and necessity.



REBUILT PASSENGER CARS USED AS STAGES BETWEEN LOS ANGELES AND BAKERSFIELD



TRUCK AND TRAILER TRANSPORT LARGE DIAMETER CORRUGATED TANKS

Holders of certificates are not restricted as to the sum they may borrow to develop business, nor does the state limit the lives of certificates, the only restriction in that connection being named in franchises secured from counties and towns through which line pass. The state does not require any license fee for commercial motor carriers other than the annual registration fee demanded for all automobiles and trucks.

The license fees charged by counties and municipalities in southern California vary widely. Some charge nothing, while others have a flat yearly charge for each car operated. In most cases a lower rate is allowed for additional cars operated by the same companies, while others base their rates on seating capacity. The City of Ontario charges interurban bus lines $200 a year for the first vehicle and $25 a year for each additional car. The City of Riverside charges at the rate of $12.50 per annum per seat. The City of Los Angeles charges the following quarterly rate for interurban stages based on seating capacity:

QUARTERLY CHARGES BY CITY OF LOS ANGELES, BASED ON SEATING CAPACITY OF STAGES

5 to 7 passengers	$6.75	16 to 20 passengers	$13.50
8 to 10 passengers	9.00	21 to 25 passengers	15.00
11 to 15 passengers	11.50	26 to 30 passengers	17.00

A quarterly rate of $1.50 per ton or fraction thereof is charged for motor trucks operating as common carriers. The annual license fee for operating a ticket office is $120.

Los Angeles County has adopted the following annual charge for each interurban stage and freight truck operating between fixed termini:

COUNTY CHARGES FOR STAGES AND TRUCKS

Interurban Stages:	
Seating capacity 5 or less	$18
Seating capacity 5 to 12	24
Seating capacity 12 to 20	30
Seating capacity over 20	36
Freight Trucks:	
Capacity, 1 ton or less	$6
Capacity 1 to 2 tons	9
Capacity 2 to 3 tons	12
Capacity over 3 tons	15

In addition to the license fee, there is an almost uniform regulation in cities and counties requiring automobile stage companies to file an indemnity bond of $10,000 for each vehicle operated. The recovery under such a bond is usually limited to $5,000 for the injury or death of one person; $10,000 for the injury or death of two or more persons in the same accident; and $1,000 for injury of, or destruction to property. The rates for liability insurance on interurban stages varies from $12.50 to $18 a month, depending on seating capacity.

So far as the author has been able to learn, no money collected from licenses for interurban stages or freight trucks by the various cities and counties is returned to a road fund.

The annual registration fee for gasoline pleasure cars is at the rate of 40c. per horsepower, while electric automobiles pay a flat rate of $5. Gasoline and electric trucks, not equipped with pneumatic tires, in addition to the above fee, pay $5 for a truck having a total weight of 4,000 lb., unladen; $10 for trucks weighing from 4,000 to 6,000 lb., unladen; $15 for trucks weighing from 6,000 to 10,000 lb., unladen, and $20 for all trucks in excess of 10,000 lb., unladen.

A maximum speed of 30 mi. per hour is allowed for cars equipped with pneumatic tires. In the daytime when the driver has an uninterrupted view of the highway for at least 400 ft., the maximum speed limit may be increased to 35 mi. per hour. The allowable speed in closely built up sections is 20 mi. per hour, and in business districts, 15 mi. per hour. The speed limit for trucks varies according to the loads and the class of tires. Trucks using pneumatic tires are allowed the same speed as pleasure cars, and trucks with solid rubber tires carrying a total load of from 9,000 to 12,000 lb., including the weight of the vehicle, are limited to 25 mi. per hour; from 12,000 to 24,000 lb., 15 mi. per hour and over 24,000 lb., 10 mi. per hour.

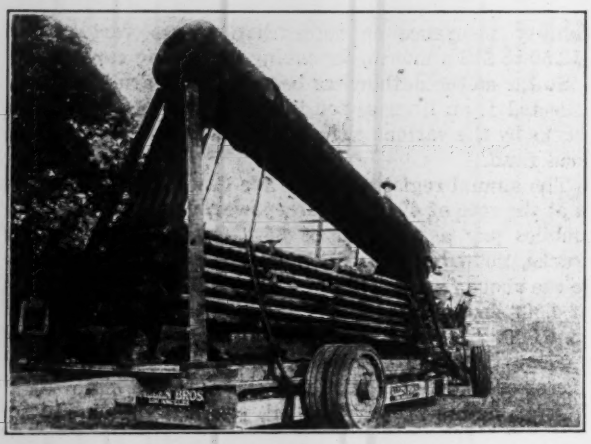
Trucks or trailers equipped with wheels wholly or partly of metal are limited to 6 mi. per hour; however, if equipped with springs and the rear wheels not less than 46 in. in diameter with a bearing surface of 18 in., the rate of speed may be increased to 10 mi. per hour. The number of trailers is limited to two, and all four-wheel commercial trailers are required to be equipped with adequate brakes. A maximum total load of 30,000 lb. may be carried on a four-wheel truck provided the weight limit of 800 lb. per in. width of rubber tire, or 600 lb. per in. width of metal tire, is not exceeded. The maximum width of tread is placed at 112 in. and the maximum width of bed or load not to exceed 102 in. Loaded hay wagons may have an extreme width of 10 ft. Severe regulations are imposed on vehicles having ridges, cleats, etc., on the circumference of their wheels. Pleasure cars and stages are allowed to carry baggage on the side, provided it does not extend more than 12 in. beyond the left side of the machine.

All money received from license fees for motor vehi-

TABLE I. TRAFFIC CENSUS ON THREE PAVED HIGHWAYS LOS ANGELES COUNTY, CALIFORNIA

	Average Daily Number of Vehicles Traveling				
Long Beach Boulevard:	Average Traffic in Tons per 24 Hrs.*	Horse Vehicles	Motor-Cycles	Automobiles	Motor Trucks
November, 1914	1,933.68	69	76	1,109	121
April, 1916	3,213.83	24	93	1,630	206
June, 1917	2,913.31	25	85	1,966	163
July, 1918	5,176.25	28	93	3,483	267
Harbor Boulevard:					
April, 1916	2,857.41	237	124	910	216
August, 1917	2,977.66	77	110	1,265	274
April, 1918	4,376.12	83	118	2,598	283
April, 1919	5,439.83	39	167	3,542	331
El Monte, Pomona Road:					
June, 1915	3,031.62	244	149	1,561	193
August, 1916	3,620.82	221	123	1,869	201
May, 1918	4,464.17	59	56	2,626	333

Long Beach Boulevard—Length 12.47 miles; in operation since March 11, 1911.
Harbor Boulevard—Length 11.33 miles; in operation since March, 1912.
El Monte-Pomona Road—Length 19.39 miles; in operation since August, 1913.
* NOTE—Traffic census over 24 hr. period for 7 consecutive days.



SPECIALLY DESIGNED TRUCK FOR CARRYING 50-TON LOADS TO SAN PEDRO SHIPYARDS

cles is placed in a state motor-vehicle fund. One-half of the balance of this fund left after paying all salaries and expenses, incident to the administration and enforcement of the act, are paid to the respective counties from which they were originally collected. The money so returned to the counties must be expended exclusively in the construction and maintenance of roads.

Interurban automobile passenger transportation has become highly organized in southern California, though many of the companies were not a financial success in the beginning, owing to the developing of a field for patrons, competition with electric, steam roads and parallel stage lines, and their failure to purchase standard equipment.

It has been found that on routes up to 60 mi. in length, cars having a seating capacity of from 16 to 25 passengers have proved the most satisfactory. Whether the 16 passenger or the 25 passenger are the best has not yet been determined. For the longer runs, such as San Diego, Bakersfield, Santa Barbara and San Francisco, cars with a seating capacity of from 9 to 12 have proven the most popular. Practically all of the late stages on the long distance runs are 12 passenger. These cars are mostly standard second-hand 7-passenger cars which have been rebuilt and lengthened so as to accommodate 12 passengers.

Truck traffic radiating from Los Angeles has been steadily increasing. Many of the merchants and commercial concerns are able to establish daily delivery by their own trucks to customers within a radius of 50 miles of the city. Coastwise vessels landing at San Pedro can be unloaded directly to trucks and the freight transported to the large wholesale houses without being stored.

Freight trucking is not as highly developed as the passenger service, due to the facts that most freight carrying companies have been operating a shorter length of time; that they are not as large; and their equipment is not nearly as well standardized. The rates charged by the different companies, for the same haul and class of commodities, vary considerably. However, their rates are generally less than those charged by the railroad, and they are endeavoring to co-operate so as to have their charges uniform.

The 77 commercial trucking companies operating out of Los Angeles own 171 trucks, five of which are ¾-ton, twenty-three 1-ton, fifty-four 1½-ton, forty-six 2-ton, thirteen 2½-ton, eleven 3-ton, eight 3½-ton, nine 4-ton and two 5-ton.

It must be borne in mind that this list includes only the trucks which operate between fixed termini and which are subject to the jurisdiction of the railroad commission and cities and counties, and does not include the great number of trucks owned by lumber companies,

TABLE II. SHOWING PRINCIPAL STAGE COMPANIES OPERATING OUT OF LOS ANGELES, EQUIPMENT, DISTANCES AND COMPARISON OF RATES

Los Angeles To	Company	Equipment — No. Cars	Equipment — Seating Capacity	Destination	Stage Fare* — Mileage	Stage Fare* — One-way	Stage Fare* — Round Trip	Railroad or Electric Fare — Mileage	Railroad or Electric Fare — One-way	Railroad or Electric Fare — Round Trip
Bakersfield and San Francisco	Eldorado Stage Co.	11	8	Bakersfield	125	5.40	None	171	5.56	None
		6	12	Taft	162	6.48	None	216	7.61	None
				San Francisco	416	14.04	27.00	484	15.34	None
Santa Barbara	Pickwick Stages	2	12	Santa Barbara	103	3.24	5.94	104	3.40	5.67
San Francisco	Nor. Division	23	8	San Luis Obispo	221	7.29	13.50	223	....	....
				San Francisco	458	14.04	27.00	475	15.34	None
	United Stages	4	8	Santa Barbara	103	3.24	5.94	171	5.56	None
San Diego	Pickwick Stages	12	8	San Diego	135	3.24	5.59	126	4.09	6.75
	So. Division	..	..	San Diego	185†	4.32	8.10	....	....	....
	United Stages	10	8	San Diego	135	3.24	5.94	126	4.09	6.75
	A. R. G. Bus Line	23	8	San Diego	135	3.24	5.94	126	4.09	6.75
Ontario, Riverside, San Bernardino, Redlands	A. R. G. Bus Line	19	20	Ontario	39	.92	1.35	40	1.09	1.85
				San Bernardino	59	1.35	2.16	60	1.74	2.92
				Riverside	56	1.35	2.54	63	1.89	3.16
				Redlands	66	1.57	2.54	65	2.21	None
Ontario	....	..	..	Ontario	39	.92	1.35	40	1.09	1.85
San Bernardino	White Bus Co.	14	16	San Bernardino	59	1.35	2.16	58	1.74	2.92
		2	25	....	....	....	....	....	....	....
San Bernardino	Golden State Tours Corp.	3	7	Gilman & Hot Springs	112	3.24	5.40	95	3.51	None
Anaheim	White Bus Line	12	16	Whittier	13	.30	.49	17.5	.41	.75
		5	22	Anaheim	28	.81	1.35	27	.86	None
		2	25	....	....	....	....	....	....	....
	Valley Stage Line	8	16	Same	Same	Same	Same	Same	Same	Same
	A. R. G. Bus Line	6	20	Same	Same	Same	Same	Same	Same	Same
San Fernando	Original Stage Co.	7	15	San Fernando	23	.54	.97	28	.78	1.32
Santa Paula	United Stages	3	8	Santa Paula	68	2.00	None	65	2.21	None
Lancaster	Golden State Tours Corp.	2	7	Lancaster	85	2.60	4.86	78	2.60	4.86

* All Rates include War Tax.
† Inland Route via Riverside.

large wholesale concerns, etc., who deliver their own commodities and do not operate between fixed termini. Practically all of these commercial trucking companies make daily trips. The motor carrier freight terminals in this city have been makeshift and are getting pretty well congested, and a concerted effort is being made to interest companies in terminal facilities which will be more in keeping with the business handled.

The work of the commercial trucks at present consists largely in collecting loads from the various merchants, and transporting the same direct to destinations without storage. This not only reduces the terminal cost, but decreases the length of time required to deliver freight from Los Angeles to the outlying districts. It is possible for this service to become so improved that retail merchants in the surrounding cities will not be required to carry as large a stock as they would otherwise, due to the delayed shipments over the railroad, thereby allowing them to turn their stock more frequently.

Transportation Association Organized

The California Highway Transportation Association was organized late in 1918. Its purpose is to advance the use of motor vehicles as carriers of passengers and property for compensation, to aid in the establishment of new business, to advise members as to proper development and expansion, to assist in securing adequate rates, to aid and assist the governing bodies in framing proper state laws so that motor carriers should have an equal standing with other common carriers. Cost of membership is $10 a year for the first car and $3 for each additional car. The association has no capital stock and it is not operated for profit.

Most paved roads which have been constructed by the California Highway Commission have a width of 15 ft. and a concrete base varying in thickness from 4 to 4½ in. Where necessary, the roadway is widened by adding a 3-ft. macadam shoulder, giving a hard surface roadway of 21 ft. A top dressing, ½ in. thick, composed of a heavy asphaltic road oil and screenings, is added as a wearing surface.

The California State Highway Commission in its annual report of 1918, stated that this thin wearing surface proved satisfactory in protecting the concrete pavement from wear except under very heavy traffic conditions, and that the thin concrete bases have given admirable service and have proved their economy under California conditions of climate and traffic, where the subgrade is well compacted. Los Angeles County, in its concrete highway construction, is using a base 20 ft. wide, a minimum thickness of 5 in., and macadam shoulders 5 ft. wide; at present a bituminous wearing surface is omitted.

Pennsylvania Registers Many Motor Vehicles

According to reports recently received from the State Highway Department of Pennsylvania, more solid-tired vehicles have been registered in that state so far this year than were registered during the entire year of 1919. The number of pneumatic tired vehicles registered, has passed the 275,000 mark, an increase of 25,000 over the same period of last year. The receipts from all sources, such as automobile tax, drivers licenses, dealers licenses, taxes upon transfer, duplications, and so forth, promise to surpass greatly the $5,000,000 mark of last year.

May Condemn for Residential District

ST. PAUL, Minneapolis and Duluth may condemn property for the establishment of restricted residence districts and exclude apartment houses from those districts. Such is a State Supreme Court decision handed down Jan. 23, 1920. The Minnesota laws of 1915 provide for a restricted residence district in cities of the first class, to be established by the exercise of the power of eminent domain, and apartment houses, among other classes of buildings, are prohibited therein. In March, 1918, the Minneapolis City Council passed a resolution creating a restricted residence district. The Twin City Building Investment Co. asked for a permit for a three-story apartment building costing approximately $50,000 in this district. The permit was refused. The company then mandamused James G. Houghton, inspector of buildings, and in due time the case was tried. The opinion of the State Supreme Court, in part, is as follows:

> The only question is whether the legislature may authorize a common council to establish by condemnation a restricted residence district which shall exclude apartment buildings and that question is whether there is a public use in such restriction.
>
> That the public gets no physical use of the premises condemned is clear. It cannot travel upon or occupy them. The use acquired, so far as the general public is concerned is, that its sense of the appropriate and harmonious will not be offended by the erection in the condemned district of prescribed buildings. . . . The notion of what is public use changes from time to time. Public use expands with new needs created by the advance of civilization and the present tendency of people to crowd into large cities . . . The term, public use, is flexible and cannot be limited to the public use known at the time of forming the constitution . . . What constitutes a public use at the time it is sought to exercise the power of eminent domain is the test . . . The constitution of this state nowhere attempts to define what may be a public use nor does it prohibit the legislature from determining what shall be deemed such a use . . . In comparatively recent times it was questioned whether a public use extended so far as to justify the condemnation of property for public parks, public baths, libraries and museums. Now condemnation and expenditure for these or similar purposes is recognized as lawful. . . .
>
> Many reasons might be suggested as sufficient for the adoption of this statute. It must be admitted that holders of land in cities have of late through selfish and unworthy motives put the land to such use that serious inconvenince and loss results to other land holders in the neighborhood. In cities where lots are necessarily of minimum size it is readily seen that when a home is built and thereafter three-story apartments extending to the lot line are constructed on both sides of a home, it becomes almost unlivable and its value utterly destroyed. Not only that but the construction of such apartments in a territory of individual homes depreciates very much the values in the whole territory. The loss is not only to the owners, but to the city and municipality by reason of the diminished taxes resulting from diminished values. It is time that the courts recognized the esthetic as a factor in life. Beauty and fitness enhance values in public and private structures, and it is not sufficient that the building is fit and proper standing alone; it should also fit in with surrounding structures. People are beginning to realize this and are calling for city planning by which individual homes may be segregated from industrial and mercantile districts and also from hotel and apartment districts. The act in question responds to this call and should be deemed to provide for a taking for a public use. . . . We think there is a public use served by the taking authorized by the laws of 1915. It does not seem to impinge any inhibition of the state or federal constitution.

Water for Shipyard Drinking Fountains Treated by Violet Rays

Filtered Through Quartz, Then Through Bone Black—High Water Consumption and Waste Fall as Temperature Lowers

By Walter L. Decker
Construction Engineer, The American Shipbuilding Company, Cleveland, Ohio

In *Engineering News-Record* of Feb. 27, 1919 p. 422, appears an abstract of an address by Col Philip S. Doane, director of the department of health and sanitation of the United States Shipping Board, on protecting the health of shipyard workers. In this, Colonel Doane speaks of the city water-supply of Wyandotte, Mich., as being diluted sewage. It may be interesting to your readers to know what steps were taken at the Wyandotte plant of the American Ship Building Co. to rectify this condition.

Prior to October, 1918, the plant had been using for its drinking water that which was furnished by the City of Wyandotte. This water was treated with hypochlorite and, on account of the excessive amount which had to be used, the water almost continually smelt and tasted of chlorine. The men seriously objected, and frequently drank the raw water from the river in preference.

As the force at the plant at that time was being increased 50%, it was necessary for steps to be taken at once to provide this increased force with a safe, adequate and attractive drinking water.

After considering the various suggestions that were made, and inquiry into the various systems that were being used, the writer decided upon ultra-violet-ray sterilization as the most convenient and simple for a plant of this description. What was desired was some system that, without supervision, so to speak, would day and night continue to function without any changes or alterations whether the incoming water contained 100 or 100,000 bacteria per cubic centimeter.

Fig. 1 shows graphically the operation of the system during September. Although the bacteria in the raw water, which is taken directly from the Detroit River, varied from 44,000 to 320,000 per cubic centimeter, at all times water free from pathogenic germs was delivered for consumption, as indicated by the straight-line sterilized-water curve, which is the fourth curve from the top of the figure.

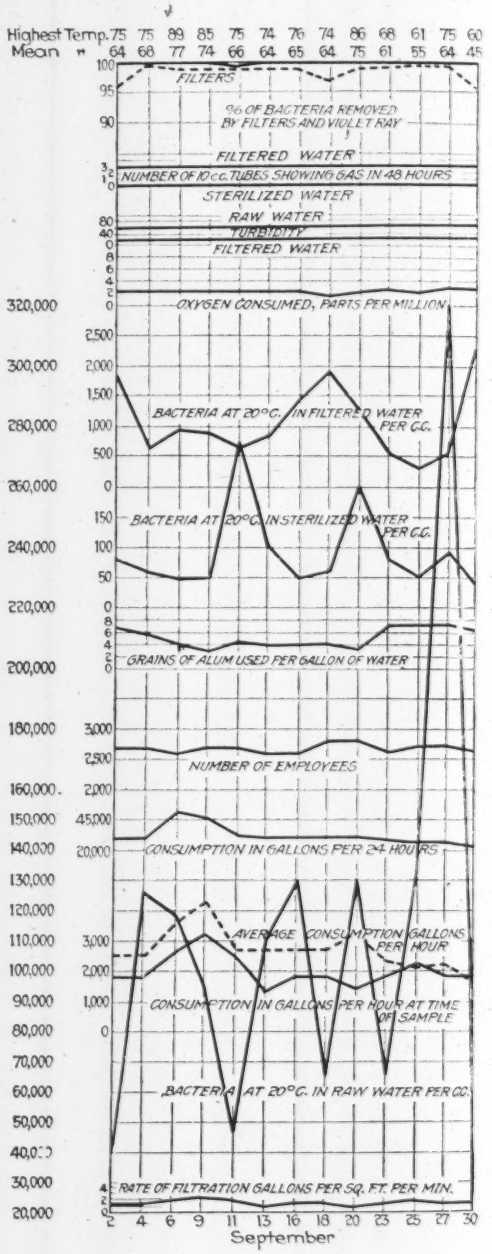
The bacteria remaining in the water after passing the filters varied from 300 to 2500 per cubic centimeter and during the entire month showed the presence of pathogenic germs, but after passing in turn through the violet-ray sterilizer they were reduced in number from 275 to 30, with the attendant elimination of all harmful germs, as those remaining were of the spore variety which are not inimical to one's health.

The system consists of one 60-in. quartz filter, two 30-in. bone-black filters, which are connected in parallel to take the water after passing the quartz filter, then two ultra-violet-ray sterilizers connected in series, for final treatment of the water after passing charcoal filters.

Since the plant was increased in capacity, seven months ago, on only three days was there any doubt of the purity of the water, and this was undoubtedly due to the combination of circumstances of a sudden, high bacterial increase in the raw water with the system operating 50% above its rated capacity.

The one uncertainty in the initial design of the plant was the amount of water per employee that the system should be designed for. As the system of drinking-water mains is entirely distinct from any domestic water lines, there is no occasion for this water to be used except for drinking.

As we were unable to find any record of the amount of water used per man, in the use of drinking fountains,


Highest Temp. 75 75 89 85 75 74 76 74 86 68 61 75 60
Mean " 64 68 77 74 66 64 65 64 75 61 55 64 45
FILTERS
% OF BACTERIA REMOVED BY FILTERS AND VIOLET RAY
FILTERED WATER
NUMBER OF 10 cc. TUBES SHOWING GAS IN 48 HOURS
STERILIZED WATER
RAW WATER
TURBIDITY
FILTERED WATER
OXYGEN CONSUMED, PARTS PER MILLION
BACTERIA AT 20°C. IN FILTERED WATER PER CC.
BACTERIA AT 20°C. IN STERILIZED WATER PER CC.
GRAINS OF ALUM USED PER GALLON OF WATER
NUMBER OF EMPLOYEES
CONSUMPTION IN GALLONS PER 24 HOURS
AVERAGE CONSUMPTION GALLONS PER HOUR
CONSUMPTION IN GALLONS PER HOUR AT TIME OF SAMPLE
BACTERIA AT 20°C. IN RAW WATER PER CC.
RATE OF FILTRATION GALLONS PER SQ. FT. PER MIN.
2 4 6 9 11 13 16 18 20 23 25 27 30
September

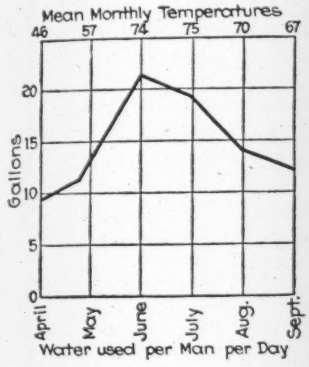
FILTRATION AND ULTRA-VIOLET-RAY RESULTS AT WYANDOTTE SHIPYARDS

in the initial design we estimated liberally the amount of water that would be consumed per man during the hottest days of summer, and multiplied this by a factor of 2. Results have proved that our factor should have been 4 instead of 2. Fig. 2 shows the amount of water used per man during the past six months.

Needless to say, this is not the amount of water con-

sumed, but it does represent the amount the system was called upon to furnish at this particular plant. The result includes all wastage, all leakage at bubblers, and breaks now and then in a supply line.

The system consists of approximately 50 drinking fountains scattered throughout the buildings and ship-building berths, and it is the outside foundations along the berths that are subject to injury and abuse. The principal loss of water is perhaps due to the length of time that a bubbler, with self-closing faucet, is held open during the time when a man is washing the tobacco out of his mouth and surveying the scenery.



WATER CONSUMPTION FROM SHIPYARD BUBBLERS

Again, if the ice in the boxes ran low the men—or more perhaps, the boys—were inclined to tie a string to or prop open the valve with a piece of wood, allowing water to run continuously, with the idea in view of obtaining colder water by this procedure. The curve shows plainly that with decreasing temperature the amount of water used per man descends rapidly to a more rational basis.

Deep Etching and Rail Defects

Further light is thrown on the discovery by H. S. Rawdon that rail fissure defects originate from internal cracks, as recently reported to the American Railway Engineering Association, as well as on the effect of the interesting new research method called "deep etching" by facts reported from the Bureau of Standards by H. S. Rawdon and S. Epstein (Technological Paper 156, Bureau of Standards). This etching is done by means of hot concentrated hydrochloric acid, allowed to act for several hours. Its effect depends upon the condition of the metal.

Steel that is heterogeneous in its chemical composition shows a characteristic roughened surface when etched. Highly stressed steel is apt to crack in the etching treatment. Hardened steel balls, for example, which contain high internal stresses due to the mechanical and thermal treatment in their manufacture, frequently crack under the acid treatment due to the progressive release of internal stresses. The behavior of the metal in this respect is identical with the well-known corrosion cracking of brasses and bronzes after cold working. Discontinuities in the metal in the form of internal fractures, however, are revealed by the deep etching as short cracks or gashes "which appear to bear a definite relation in their arrangement to the direction of the stresses to which the piece had previously been subjected." The fact that the original defect is a crack has been fully demonstrated by covering the surface of the metal with iron filings and subjecting it to magnetic action, as already reported, and also by opening up the cracks by means of wedging, after they had been located by the magnetic method. It appears therefore that the rapid solvent action developed in deep etching supplies an important new method of examining steel.

All Sand Aggregate for Concrete In Middle Western Roads

By T. L. Brockway
City Engineer, Wichita, Kansas

Abstract of a paper read before the American Society of Municipal Improvement at New Orleans, November, 1919, under title, "Sand Concrete." This paper was a "volunteer" one; that is, it was not on the program and for that reason it did not receive much discussion. —Editor.

Material, price, and labor embargoes during the war made it practically impossible in certain parts of the Middle West to secure any gravel or broken stone of the size generally used in concrete as concrete aggregate. Roads had to be built, and particularly those which were torn up had to be repaired, so the expedient was hit upon in certain parts of Kansas of using a concrete with an aggregate made up entirely of sand, most of which passes a ¼-in. sieve. Tests of the concrete so made and observations of the road foundations and surfaces in place seem to show that the method is quite satisfactory.

A large territory in the western slope of the Mississippi River Basin is practically without rock which is at all suitable for use in concrete pavement, and barely possible even in the construction of concrete base. French coefficients of 1.6 to 5 in various ledges of quarries which formed the only available source within a reasonable distance are not uncommon. For this reason soft, chalky limestone of this lack of toughness has been extensively used in making concrete base for pavements. The usual mix has been 1:3:6, the crusher run of stone passing a 1½-in. sieve and retained on ¼-in. The depth of such base varied from 4 to 6 in.

Partially offsetting the lack of rock is an abundance of sand carried by the rivers, past and present, flowing down from the Rocky Mountains. Bank sand of good quality is found in many places. River sand is inexhaustible in the Missouri, Platte, Kaw and Arkansas Rivers and many of their tributaries. Pumps and dredges are in common use on these streams. Not all the sand is good, depending on conditions of flow under which it is deposited, but good sand is available in all of them.

In the early winter of 1917, oil was discovered near Wichita, Kan. Road improvements were demanded by the residents and approved by Federal authorities because of the necessities for growth caused by the oil developments, but stone aggregate was impossible to get. At this juncture a study of sand concrete was made.

The city of Wichita is located at the mouth of the Little Arkansas River at its junction with the Arkansas River. The Little River sand runs coarse. A pump operating about five miles from the mouth regularly furnished sand, of which 15 to 20 per cent is retained on a ¼-in. screen. This gravel is nearly all granite, some shale and quartz. It is subject to the same objection as rock, so far as the city pavements are concerned, that of car shipments, and is furthermore sandwiched with clay seams which develop tough balls under the action of a pump.

For a mile above the mouth of the Little River the Big River runs nearly due east after making a right angle turn from a south direction of flow. The prevailing winds during the season when the river is dry

are from the south and southwest. These winds have piled high dunes of "blow sand" on the east bank of the north and south portion of the river. This fine sand is remarkably clean and sharp. About 35 per cent passes an 80-mesh screen and practically all passes 40 mesh. Large numbers of similar dunes lie along the river where wind conditions have been favorable.

Sand in this locality which is easily available has the following screen analysis:

Through	Retained	Per Cent
	On ¼ in.	6.25
¼ in.	No. 6	5.0
No. 6	No. 20	38.75
No. 20	No. 30	20.0
No. 30	No. 40	10.0
No. 40	No. 50	15.0
No. 50		5.0

The percentage of voids of this sand is found by a number of tests to be very close to 28 per cent.

Calculations to determine the amount of cement possible to use with this sand without making concrete more expensive than by using rock at local prices are as follows:

	1:3:6 Rock Mixture	Sand and Cement
Rock on track	$2.24	
Delivering rock	1.25	
Sand delivered	.08	$1.50
Cement delivered	2.50	5.37
Labor mixing and placing	1.40	1.20
Total	$8.07	$8.07

At $2.50 per bbl. of cement, $5.37 will buy 2.15 bbl. cement or 8.6 cu.ft.; 8.6 cu.ft. per cu.yd. allows one part cement to 3½ sand, not allowing for any increase in volume of the sand on account of addition of cement. Because of the surplus of cement in this mixture over that necessary to fill the voids in the sand and because of the practical difficulty in obtaining a mixture of sand of this odd small fraction, a cement-sand mixture of 1:3½ was selected for experimentation.

With this revision the cement necessary per cu.yd. of concrete becomes 1.93 bbl., worth $4.83, or a total cost of $7.52 per cu.yd. for concrete in place. This cost has been proved very nearly correct for good working conditions on 6-in. base by actual experience this season and to be about 20c. per cu.yd. too low on an average where 5-in. base is laid.

Small beams were then made of identical size under identical conditions by the same person. They were cured in a room where the temperature was about 80 deg. F., being kept covered with sacks which were thoroughly wet daily. Stone and sand were taken from stock piles. Cement was the same in all cases, being a standard brand passing standard tests with a good margin. The beams were broken at the ages specified below, over the same support, by loading with paving brick which were so stacked as to prevent arching action. The result of the tests follow:

COMPARATIVE TEST OF STONE AND SAND CONCRETE

Beams 6 in. wide.
Depth of 1:3½ and 1:3:6 mixes = 5 in.
Depth of 1:4 mix = 6 in.
Distance between supports 4 ft. 10 in.
Distance between loads 1 ft.
Loads equal and spaced equidistant from center.

Mixture	Age	Extreme Fiber Stress, Lb. Sq. In.
1:3½	34 days	182
1:4	34 days	152
1:3:6 rock	34 days	188
1:3½	60 days	212
1:4	60 days	180
1:3:6	60 days	190
1:3½	90 days	220
1:4	90 days	178
1:3:6 broke in handling		

A very noticeable difference was the character of the fracture. In each case of the sand mixture the break was clean and sharp, while the rock mixture shelled badly. Several individual pieces of rock were so thickly coated with dust that there was practically no adhesion of the mortar matrix. This is to be expected of that part of the ledge in the quarry having a coefficient in the neighborhood of 2.

No tests were made of crushing strength because that is not the governing factor in any failure of paving base which has been observed. Failures have been practically always from unequal settlement of old fills or over open spaces caused by settlement of ditches or undermining by leaky water mains. In all of these the beam action of the base has been called into play. Other failures have been that of cracking under tension caused by soil shrinkage under conditions of extreme drouth.

Specifications For Use of Sand

With these tests and local conditions of materials available, together with the desire to insure continuity of supply, the following clause was added to the specifications for concrete base:

The concrete base may be mixed with sand and cement or a mixture of gravel and cement instead of the mixture of sand, cement and stone, under the following conditions: Little River sand free from loam, clay or other impurities, or coarse sand from other sources of which approximately 5 per cent is retained on a ¼-in. mesh sieve and not over 6 per cent passes a 50-mesh sieve and whose voids do not exceed 30 per cent, may be used in making concrete, using one part cement to three and one-half parts sand, volume measurement.

The percentage of cement may be reduced for sand containing more than 10 per cent of particles retained on a ¼-in. mesh sieve in such proportions that the ratio of cement to the sand which passes a ¼-in. sieve is not less than one part cement to three parts sand.

Well graded gravel, 95 per cent of which is retained on a ¼-in. screen and which is of good, hard, sound material may be substituted for rock and used under the same proportions as provided for rock concrete.

As a result, the sand mixture has been used in all of the paving construction. Four hundred thousand yards of pavement have been contracted for this year, and practically all of the base will be laid by the close of the season. Had it been deemed necessary to use rock it would not have been possible to lay more than half of this amount because of the car situation and uncertainties of labor. In support of this statement, it might be well to state that a contract was let for the construction of a concrete highway in May of this year amounting to 75,000 sq.yd. Stone requiring a haul of about 250 mi. was purchased for the work. Approximately 10,000 sq.yd. will be completed this season. Not all the delay was caused by lack of stone, or even cars to ship it in. The construction of a plant to handle the stone consumed considerable time. The lack of labor at critical times has consumed more.

As to the quality of the base, made with a 1:3½ mix of cement and sand, a great many cuts have been made in various places and in every case it has been tougher and harder to cut and break than base made with the chalky limestone available within a reasonable distance. One place in particular was observed in which a new sewer ditch was inadvertently covered before being flushed. The base was broken through within two weeks to remedy this defect and was found to be carrying

heavily loaded trucks from adjacent flour mills without support for 6 ft. in width and about 40 ft. in length of the ditch. It required repeated heavy blows of a 16-lb. sledge to break small pieces along the edge of the base after it was opened. The impact produced a ringing sound similar to that of striking flinty stone.

These observations, together with the behavior of crossings and gutter, made of the same material, under traffic, led to the construction of a block of concrete pavement in the fall of 1918. This was mixed one part cement to three parts sand, laid six inches thick and finished with roller and belt.

Cross expansion joints of creosoted wood were placed 30 ft. apart and precast asphalt joints ½-in. thick placed against each gutter. This pavement was laid on a street 36 ft. wide between gutters with a construction joint down the center. A three months' period this season, in which less than 2 in. of rain fell, produced such enormous soil shrinkage that a longitudinal crack has appeared near each quarter of the street for about two-thirds of its length. Otherwise the pavement is in perfect condition and has been the means of bringing in petitions for 75,000 sq.yd. more during the present season.

The mixture was specified as follows:

> The mixture shall consist of one part cement to three parts clean, sharp sand which contains not less than 5 per cent of material retained on a ¼-in. mesh screen. Sand which contains more than 15 per cent of material retained on a ¼-in. mesh screen may be mixed with cement in such proportions that the sand passing a ¼-in. mesh screen will be 2½ times the amount of cement used. The total amount of gravel retained on the screen shall not exceed the amount passing it in the mixture of the two.

Contracts have been awarded at $1.90 to $2.00 per square yard, exclusive of excavation.

In construction it was discovered that if the mixture was made as dry as is now commonly specified, it was impossible to prevent deep shrinkage cracks from developing within a few minutes after depositing the mixture. During the extreme dry weather the subgrade was flooded thoroughly just ahead of the concrete and checking was only stopped by using all the water the mixture would carry without separating and then spraying water over it within 15 min. from the time it was laid. This liberal use of water prevented all checking except the usual setting shrinkage cracks which occur transversely about every 30 ft. from a week to ten days after the concrete is laid.

Paper Gate Replaces Clay in Jointing Cast-Iron Pipe

For jointing pipe with metalium an oiled kraft paper gate has been invented which reduces the amount of clay putty to that used about the bottom of the gate. A high gate is essential in pouring this material and in many localities the proper clay is not readily available. In addition the workmen, especially in cold weather, lost much time in working up to the proper consistency the large quantity required.

For jointing pipe having a diameter of 8 in. or less, the paper gate is 10 in. high and fits over a No. 30 gate peg 2 in. in diameter at the bottom and 2¾ in. at the top. The peg is slipped into the paper tube flush with the bottom edge and then set up as usual with only enough clay around the bottom to prevent the escape of the hot metalium.

Resurveys of Old Railway Lines

Lack of Records of Original Construction and Subsequent Revisions Necessitate Surveys for Alignment, Profile and Property Lines

By J. G. Wetherell
Assistant Engineer Chicago, Milwaukee & St. Paul R.R.

RESURVEYS to determine alignment, profile and property lines are necessary on many railway systems composed extensively of lines first built as small independent railways. This is true of the Chicago, Milwaukee & St. Paul R.R., and the writer was in charge of such resurvey work during the fall and winter of 1918. In many cases the original construction notes had been lost. Where original maps and profiles exist it has been found that these were not followed exactly during construction and since then there have been a number of minor revisions not recorded.

For valuation purposes it was decided that the Southern Minnesota Division, the Dubuque Division and the Chippewa Valley branches of the River Division should be among those resurveyed. The writer was instructed to organize a party and work out the method of precedure. This survey was not to be a pre-inventory, as the Federal valuation parties were taking or had already taken off quantities on these lines. The railway company had competent men with each Government cross-section party and recorder party, whose duty it was to see that nothing was overlooked. It was decided, therefore, that the resurvey party would consider as correct the grading and track material quantities of the previous parties.

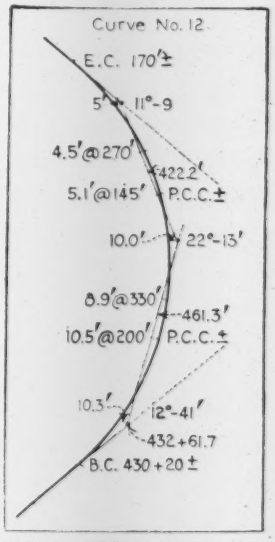


FIG. 1. FIELD NOTES OF CURVES IN RAILWAY RESURVEY

The resurvey party was to consist of one assistant engineer in charge, one instrumentman, one levelman, two draftsmen, three rodmen and two chainmen. However, men were scarce in 1918 and it was only during the last six weeks of the work, when men were released from the valuation parties, that the resurvey party was complete.

Three box cars, fitted out for the purpose, formed the office and camp equipment. One car was used for an office and was fitted with extra long windows and two drafting boards. An old coach with the seats removed and a stove installed in the center would have been better for an office car and less expensive, but on account of troop movements, no coach could be spared. A gasoline motor car was used for going back and forth. This was light enough to be handled easily by one man and it had considerable speed and power, but there were times when a larger car would have been better.

Field work was divided by the writer into the following five classes: Survey, alignment, profile, original ground line and land ties. The office work consisted of

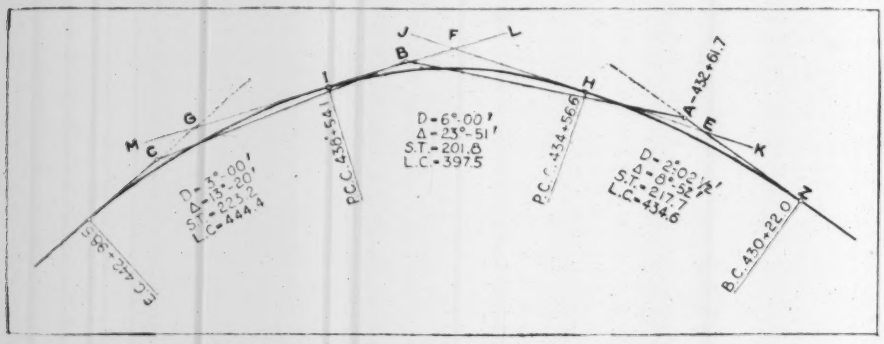


FIG. 2. PLOTTING TRAVERSE OF CURVES

making the profile tracing and right-of-way detail, besides doing miscellaneous figuring and checking.

The survey work consisted of main-line chaining and ordinary station-ground surveys at and between towns. The beginning of the division was taken as Sta. 0, and stationing was carried through, thus eliminating all equations, etc., in the original surveys. The party of three men covered, on an average, 8 or 9 mi. a day for each day worked.

Alignment and Curves

The alignment work, which consisted in determining the degrees of the curves and their stationing, was the most interesting part of the resurvey. All curves were intersected when possible, angles and externals being measured. There were a number of long curves, also a number of compound curves that could not be intersected. These were traversed, a sample of the field notes being shown in Fig. 1. Where the curves are long and compounded (as many as five times in some instances) this method is better than the deflection method.

Each curve was sketched in the field, one curve to each page in the notebook, care being taken to sketch curves to right or left as they were on the ground. When curves were close together it was found that two transits could be used to excellent advantage. This eliminated all backward movements for intersections, etc., everyone working ahead all the time. In using two transits, it was found advantageous to have sights set at each end of the tangents. This was generally done the previous afternoon, using the motor car. Sights were made of ten-penny nails and scrap detail paper cut into pieces about 2 x 3 in. Where tangents were long the party generally used the motor car to get from one curve to the next.

True bearing was established by sighting on polaris. This was checked often to see that no errors had been made in the angles. The regular alignment party consisted of an instrumentman, a rodman and two chainmen, all of whom were particularly good men. The best day's work with one transit was on the Dubuque Division when 27 curves were run.

For the profile, the work consisted simply of running a profile of the base of rail, U. S. sea-level datum being used. All existing Government bench marks were checked on, but these were found only on the Dubuque Division, along the Mississippi River. Bench marks were established near each station and also at intervals of about a half mile. No monuments were set, but existing features were used and well described. This was the only part of the resurvey that was not liable to be slowed up by curvature, towns, etc., and eight miles was the average day's work.

The original ground line was obtained generally by the levelman on days when he was not running profile. By using a hand level the cuts or fills at the sides were determined and interpolated for center line. On sidehill cuts, where it was impossible to determine original ground, the amount of cut was taken from the old profile. It will be hard for anyone to prove it is wrong. Land ties were generally taken by the alignment party as they came to them. This work consisted in turning angles to fence lines and measuring to the section corners; or, in the towns and cities, of turning angles to important street lines and measuring to street corners.

Profiles were plotted on standard profile tracing cloth, in 20-mi. sections. Standard conventions were used. One draftsman did all profile work, and could about keep even with the field forces when they were making average progress.

Determining the degrees of curves and their stationing from the notes taken in the field by the alignment party was an important part of the work. The necessary equipment consisted of a large paper protractor, a 36-in. straight edge, a prick point, a scale and a table of natural tangents, and curve data. A typical example is explained in the following, using field notes as shown in Fig. 1.

Plotting of Curves

The traverse is plotted very carefully on a scale 1 in. to 50 ft. Tenths of a foot can be plotted on this scale. This is shown at A, B, C in Fig. 2. The ties to the curve are then plotted and curve templates applied, care and judgment being used to see that there is no excessive "throw" and that the curves as drawn, to best fit the points, are tangent to each other and to the main tangents at each end. In Fig. 2 it is found that a 2-deg., a 6-deg. and a 3-deg. curve fit the best and that they are tangent to each other at about H and I. The line JK is drawn, a common tangent to the 2-deg., and the 6-deg. curves, and the line LM tangent each to the 6-deg. and the 3-deg. curves. These two tangents intersect each other at F. Other intersections are at E and G.

It is better to work each way from the center; so establish the center curve as a 6-deg. Scale angle HFI for the 6-deg. curve, which is found to be 23 deg. 51 ft. The tangent distance and the length of curve are figured and found to be 201.8 ft. and 397.5 ft. Points H and I are then scaled as 201.8 ft. from F and are the P. C. Cs. Angles HEA and CGM are scaled, also distances EG and IG. These are respectively the intersection angles and the tangent distances of the curves at the right and left.

Having these two conditions fixed, the degree of the curves is found to be 2 deg. 02½ ft. and 3 deg. The lengths of curves are then figured and we have all curve data except the stationing. EA is scaled as 22 ft. This added to 217.7 ft., the tangent distance of the curve at this end, gives 239.7 ft., equal to AN. This

distance subtracted from Sta. 432 + 61.7 gives Sta. 430 + 22 as the B. C. of the curve. The stationing of the points of compound curves and the end of the curve is then found by adding the curve lengths.

There may be some criticism of the above on account of excessive scaling. The writer does not claim that this method would necessarily give the best alignment for staking curves for lining track. It is, however, close and sufficient for map purposes. A party staking a compound curve for track lining could easily spend a day at it, and the next day an equally good party might stake it differently.

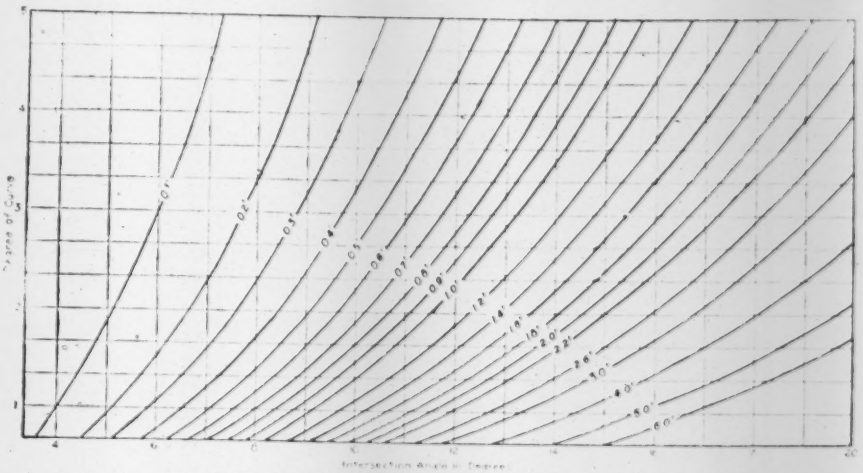


FIG. 3. CHART SHOWS AMOUNTS TO BE ADDED TO HALF LENGTH OF CURVE TO OBTAIN TANGENT DISTANCES

The right-of-way detail was made on a scale of 1 in. to 400 ft., using standard conventions, etc. The center line was plotted by co-ordinates, the point of intersection of each curve being plotted and the sub-tangents scaled each way. This is the same method used in railway location work. The laborious task of figuring the latitudes and departures was simplified by the use of a Gurnsey traverse table, one man calling out of the book and another tabulating. Every party on location or resurvey work should have a traverse table.

At the end of each division there was a thorough checking of profiles. This included checking bridges and culverts against existing bridge books, curve data, bench marks, elevation lines, mile-posts, stationing, etc. Among the things checked was the labeling of the grade line "base of rail" every 4 mi. In too many cases a profile fails to show whether the grade line was subgrade, base of rail or top of rail. As a rule there were found some things that were indefinite and needed a better checking. These were all listed in order and three men went back over the line on the motor car to get them, while the rest of the party moved to the new division. From 75 to 100 mi. could be checked thus in a day.

Chart for Tangent Distances

Of great assistance in this resurvey work was a chart devised by the writer for determining the degree of curvature, having given the intersection angle and the external. This chart was described in *Engineering News-Record* of Sept. 11, 1919. p. 506.

A chart for determining tangent distances, shown in Fig. 3, was devised by C. E. Sandstedt, assistant engineer on the resurvey work. Degrees of curves are plotted vertically on standard cross-section paper on a scale of 1 deg. to 3 in. and intersection angles plotted horizontally on a scale of 1 deg. to 2 in. Graphs show the amounts to be added to half the length of curve, to obtain tangent distance. This chart should be a time-saver, as it is not a small task to figure the tangent distances of a number of curves by ordinary methods, especially if the degree of curves happen to have odd minutes.

All resurvey work was done under the general supervision of T. H. Strate, valuation engineer, and C. F. Loweth, chief engineer of the Chicago, Milwaukee & St. Paul R.R. C. E. Sandstedt was assistant engineer in direct charge while the writer was temporarily assigned to other work.

Gen. Leonard Wood's Views on the Engineer

Candidate for Republican Presidential Nomination Reviews Engineer's Part in Colonial Affairs and in War — Favors Permanent Engineer Reserve

SPEAKING before the Western Society of Engineers at its recent annual meeting General Leonard Wood, U.S.A., candidate for the Republican presidential nomination, presented his views regarding the work engineers have done and the position they should occupy in the conduct of our national affairs. An abstract of his remarks follows:

"In colonial development, the administrator, the sanitary engineer and the constructing engineer seem to go together. In Cuba I had to turn to the engineer when we had the problem of creating a republic out of some two million people of a war-worn Spanish colony, absolutely without government and with everything in wretched condition. We had to begin with building and rebuilding roads, piers, public buildings and harbor works. The sanitary engineer went along with the constructing engineer and their work was a great and helpful force. We organized a cabinet in preparation for the president who was to come. In this we had a secretary of public works in charge of a department of public works, all of the work of which was done under a budget system, twenty years ago. I have often thought it would be a good thing for this country, with its enormous amount of public works, to have such a department with some responsible person at the head.

"The Panama Canal was built on the foundation laid by the sanitary engineer. It was founded on the work of Walter Reid, in Cuba, who was the directing mind in the discovery of the means of transmitting yellow fever and consequently the means of controlling it. While General Ludlow, the distinguished engineer, was Governor of Havana, and I was Governor of the eastern end of the Island, yellow fever one year swept away a third of my staff in six weeks and the next year it

took a fourth of them in three weeks. Then came Reid with his remarkable discovery, and Willimar, Lazarre and Carroll laid down principles and lines of action which enabled us to wipe out yellow fever. The French were good engineers, but they had not been able to go on with the Panama Canal work because the death rate was so heavy. It takes nothing from the honor of the constructing engineer to give due credit to the medical man and the sanitary engineer who made the work possible.

In the Philippines, the engineer again became our right-hand man and was the principal agency of the colonial administration in building bridges and making other developments.

THE ENGINEER RESERVE CORPS

When the great war came and some of us were trying to interest the people in preparedness, we built up the Engineer Reserve Corps, which came next after the organization of the Medical Reserve Corps. At that time I had command of the Atlantic coast, Panama and Porto Rico and had to lay lines of defense around the great cities. It occurred to me that we should have engineers available in all these cities, as in building the defenses what better men could we have than those who live there and know the contractors, the resources of the city and the sources of supply. It impressed me that there was a chance to make immediate and valuable use of the engineer. So one day, at a meeting of the Engineers Club in New York, we organized the Engineer Reserve Corps, which has been of wonderful use and ought to be kept up permanently. In case of sudden emergency it would be of the utmost value to have these engineers, who could take the plans and carry out the work with the greatest rapidity. To keep alive the reserve corps is your big part in the scheme of national defenses.

"As to the great war, there has never been a war in which the engineer and the sanitarian played so large a part; in destructive and constructive work, and the development of railways and ports. We went through this war in most extraordinary fashion. By the work of the sanitary engineer our men were kept healthy, though living under conditions which would have meant death a few years ago.

"An alliance between engineers and architects in evolving some general policy of building construction in our great cities is desirable. We have sanitary regulations but no regulations to prevent monstrosities from being inflicted upon the public, while we should have our works of utility built so that they will be works of beauty."

Reports 82 Per Cent Price Rise

An increase of 82.2 per cent in the cost of living for American wage earners between July, 1914, and November, 1919, is shown in a statement issued Dec. 28 by the National Industrial Conference Board, based upon its most recent investigations. This represents an advance of 10.4 per cent since November, 1918, 13.5 per cent since March, 1919, when prices dropped temporarily, and 5.8 per cent since last July. The increase in the cost of the five major items in the family budget since July, 1914, was: Food 92 per cent, shelter 38 per cent; clothing 135 per cent; fuel, heat and light 48 per cent, and sundries 75 per cent.

Decay of Factory Roofs Checked by Proper Heating

Artificial Humidity and Ineffective Arrangement of Heater Pipes Conduc to Rapid Decay of Wooden Roofs

DECAY of timber roofs of industrial buildings in which a humid atmosphere is maintained can be checked by proper arrangement of heating pipes under the roof, according to a pamphlet prepared as a reprint of a paper read before the American Society of Heating and Ventilating Engineers by F. J. Hoxie, engineer and special inspector of the Associated Factory Mutual Insurance Cos., Boston, Mass. Such arrangement will also reduce the trouble due to water dripping from the ceiling in cold weather.

Destruction of sawtooth roofs of weaving sheds by decay is stated to have progressed to an alarming extent within the past few years. The primary cause is the artificially humidified air with a relative humidity of 70 to 80% at 70° F., which means that 1 cu.ft. of air will contain about 6 grains of moisture and the dew-point will be 62° F. A drop in temperature of 10° will cause precipitation of drops of water. Modern weaving buildings have large roof and window areas exposed to the cold in winter, the result being that the part of the roof plank which is at or below the temperature of the dew-point of the interior air absorbs sufficient water to come within the requirements of some of the wood-rotting fungi. Mr. Hoxie considers that the location and extent of the heating pipes will generally be found to have a direct bearing on the location of the parts most rapidly destroyed.

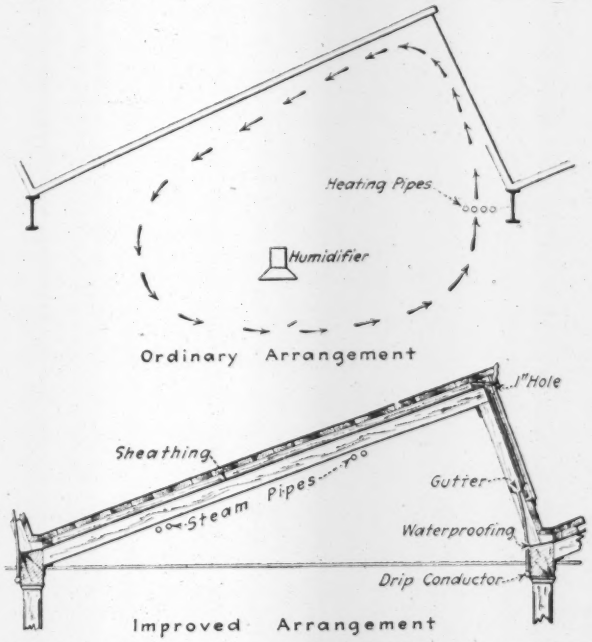
In a weaving shed where a heating coil extended half the length of a bay, the part of the roof over this coil has been in place 18 years and is still in service, while the remainder of it has had to be replaced. The center sawtooth in a shed 500 x 350 ft. has the main steam pipe at its base and extending three-quarters the length of the building, while the circulation pipes are in the customary location under the windows. This sawtooth is apparently in a good state of preservation as far as the steam pipe extends, fungous growths commencing directly at the end of this pipe, while the remainder of the roof has been replaced after nine years' service. It appears that better results can be obtained by locating part of the steampipes at the back of the sawtooth, farthest from the windows. In one case where the pipes were located three on each side of the bay, the roof is still in service at the end of 17 years, although other parts of this same roof, where all the pipes are under the windows, have rotted and have been replaced.

Metal ventilators, metal roof drains, skylights and windows which radiate more heat than other parts of the roof and thereby keep the air in the vicinity cooler than in other parts of the building, will accelerate the destruction. The cure, as suggested by Mr. Hoxie, is to prevent the escape of heat by increasing the insulation; using steampipe covering for drain pipes and heavy plank for ventilator openings. Double roofing will increase the insulation, but a layer of tarred paper should be mopped on between the two thicknesses of plank so as to prevent the interior moisture from passing through and saturating the outer portions, thereby decreasing the insulating power and starting rot in the

outer or center part of the plank, which is very common.

It may be more convenient to increase the amount of heat than to reduce the loss by increased insulation. Either method will produce the same effect if care is taken to prevent the moisture from penetrating the roof plank and condensing on the outer side. This is particularly important if absorbent felts have been used on the outside of the roof for insulation, in which case the moisture will reduce the insulation and also encourage fungous growths.

Sheathing the inside of roofs to form an air space has been used in several cases to increase the heat insulation and prevent sweating, and is generally regarded as an efficient remedy, but Mr. Hoxie considers that the air space is of little value as a heat insulator and makes an excellent place for the propagation of



ORDINARY AND IMPROVED ARRANGEMENTS OF HEATER PIPES AT SAWTOOTH ROOFS

fungi. Moisture can pass through the sheathing and become pocketed under the roof planks, which space is colder than the room and generally below the dew-point, with the result that an abundant growth of destructive fungi occurs. In a case where rotting had started in a comparatively new mill, holes were bored to the outside air and covered with a strip to keep out the weather and at the same time to allow the moisture to escape and dry outer air to enter, the heat of the room keeping the space between the roof plank and sheathing above the dew-point of this drier air from outside. Moist air of the room is carefully excluded from this space.

Moisture carried by air currents set up by the heating pipes is next in importance to the dew-point of the air in causing rot in roofs. The arrangement of heating pipes commonly found in sawtooth roofs, as shown in the drawing, causes a circulation of air as shown by the arrows, so that moisture from the humidifiers will be carried up and deposited on the cooled windows and roof, not only rotting the woodwork but causing dripping. The arrangement of heating coils shown in the lower part of the drawing should reduce the air circulation by keeping the highest part of the roof at the highest temperature, thereby preventing the air from carrying moisture to the roof planks.

Paper mills and finishing works, says Mr. Hoxie, can be improved by more ventilation, as the problem there is to get rid of the moisture. Where large quantities of moisture are to be disposed of, this will require a large amount of air, and provision should be made not only to remove this air but to admit and heat sufficient air to meet the requirements of the exhausting system without running part of the air circulation system backwards, as is frequently done. That is, the exhaust ventilators, instead of carrying away the moisture-laden air, are admitting cold air in one part of the room, owing to a considerably higher temperature under the ventilators in another part. This occurs when ventilation is produced only by differences in temperature.

If fans are used and no provision is made to introduce dry, warm air in sufficient quantities to replace that removed, cold air will be drawn in around windows or doors and will cause precipitation and rotting of the wood thus kept moist. An opening near the floor is advisable, with suitable steam coils for warming the incoming air and supplying it in sufficient quantities to keep the air of the room at a reasonable moisture content, which, to avoid rotting, should be not over 6 grains of water per cubic foot. In a large paper mill or finishing works (sometimes evaporating more than 50 tons of water per day) this will require a large amount of air. Mr. Hoxie believes it may be possible to increase the economy of this ventilation by returning some of the latent heat of evaporation of the outgoing moisture to the incoming air by use of an air condenser in the ventilators, but he has never heard of this being done.

Rotting in moist basements can be stopped more frequently by sufficient radiated heat to keep the contained air above the dew-point than by ventilation, as it is generally difficult to control the temperature of outside air used for ventilation. The introduction of cold air into a warm, moist basement will cause rotting rather than prevent it, as it will reduce the temperature and precipitate moisture, while the introduction of a small amount of heat into such a basement will raise the temperature above the dew-point and thereby stop the rotting. Several cases have been found where steampipes near the ceiling of a basment had prevented rotting even when the ground underneath was covered with water. The water, being colder than the ceiling, assisted in preventing precipitation by regulating the amount of moisture in the air.

Hetch Hetchy Tunnels Completed for $65 Per Foot

The following is extracted from a statement made on Feb. 23 by M. M. O'Shaughnessy, city engineer of San Francisco:

"The City Engineer's department has already excavated 2 mi. of tunnel on the Hetch Hetchy project at $40 per lineal foot, and has figured out that it can do the concrete lining at $20 per lineal foot, with an allowance of $5 for extras. Total, $65 per lineal foot. The lowest bid the city got for this tunneling construction was $93 a lineal foot for a tunnel of more than 10 ft. in diameter excavated, cement-lined and finished. The saving works out at nearly $150,000 per mile of tunnel."

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Correspondence

Sir—The article by Mr. Fleming in your issue of Feb. 12, p. 322, recommending the publication of a history of engineering, is the first public expression I have seen that any one else has realized the great necessity for such a work, and is certainly encouraging to those of us who have spent much time and labor toward the realization of this desideratum. Many years ago I recognized the necessity of such a work and plunged directly into the weighty undertaking. By reading over the classics and other ancient books, by ransacking libraries, I collected numberless notes, which, arranged in chronological and technical order, were finally condensed into three volumes under the title "The Engineering Works of the Ancients and of the American Indians."

I passed through the experience foreseen by Mr. Fleming that no editor would undertake the risk of publication of such a work. The most prominent editors of the country have refused to accept a work for which there is so limited a market, and the technical publishers claim that engineers are too busily engaged in the progress of the profession, always looking after the most up-to-date methods, that they have not the time to inform themselves about what has been done in the past—and that they do not care to do so.

I firmly believe that a history of engineering would be very useful to both scholars and engineers. It would prevent the student from misstatements and anachronisms. For instance, in the latest edition of the Brittanica the invention of locks is credited to the two brothers from Viterbo who built a lock at Stra in 1481; and yet Leon Battista Alberti in his "De Re Aedificatoria," published in 1450, describes locks in chapter xii. Even the most up-to-date engineer may find it advantageous to know the works of the Ancients. William Willcocks, intrusted with the drainage and irrigation of the delta of the Euphrates and Tigris, after a careful examination of the topographical and physical conditions of the locality, suggested the rebuilding of the works constructed by the ancient Chaldeans some thousand years before the Christian Era. After the British occupation of Egypt engineers were appointed to extend the benefit of irrigation to land not directly reached by the annual floods of the Nile. It was proposed to store the high waters in a large reservoir to be constructed either at Assouan or at the locality of the ancient Lake Moeris. The Moeris was visited and described by Herodotus, who says: "For many months the water of the river enters the lake, and for many more the water from the lake enters the river." At the last moment the Assouan dam was decided upon, and the flooding of the Island of Philae, threatening the destruction of the best monuments of the Ptolemaic period, justifies the preference of the ancients for the Moeris, a work which, according to the Arab tradition, is credited to the Patriarch Joseph mentioned in the Bible. The ruins of the Etruscan cities and necropolis encountered in the swampy places infested by malaria where no human being can now live, indicate that the lands were drained either by the Etruscans or their predecessors. These drainage works consisted of a network of cuniculi extending in every direction and for thousands of miles in length which later engineers have been unable to re-establish or duplicate. If professional men were better acquainted with the works of the Romans or those of the Peruvian engineers in pre-Columbian time, the world would have had reinforced concrete centuries before it came into modern practical use.

These few examples taken at random will show how useful would be a history of engineering to the profession. A thorough history of engineering should be composed of three separate parts, the first devoted exclusively to the engineering of ancient and medieval times, and I have prepared such a manuscript. The second part should be devoted to modern engineering, each branch of the profession being treated by a specialist, and finally the third part should consist of a dictionary giving a biographical sketch of all the prominent engineers, their works and contributions toward the advancement of the profession. CHARLES PRELINI.

New York City.

American Engineers' Handbook Revised

AMERICAN CIVIL ENGINEERS' HANDBOOK—Editor-In-Chief Mansfield Merriman. Fourth Edition, Thoroughly Revised and Enlarged. New York: John Wiley & Sons, Inc., London: Chapman & Hall, Ltd. Flexible Cover; 4 x 7 in.; pp. 1955; illustrated. $6.

Only a page by page comparison would reveal the exact changes in this latest edition of a book which has become a standard reference—and as the third edition had 1,580 pp. and the present or fourth edition has 1,955 pp. that task has not been attempted. Suffice it to say that two new sections—on Electric Railroads (55 pp.) by William A. Del Mar and on Irrigation and Drainage (63 pp.) by Horace W. King—have been added; that Searle's useful mathematical tables have been interleaved on colored paper; and that many revisions and additions have been made by both old and new authors in the effort to bring the book up to 1919, when the fourth edition closed. Also the volume is no longer a "pocketbook," which it never was except by title, but is now a "handbook."

Scattering examination shows some unevenness as to completeness of revision. In the treatment of concrete as a material, for instance, none of the recent studies into proportioning, aggregate or water content are noticed; the matter seems not to have been revised since the second or possibly the first edition. On the other hand the freight handling and port terminal section contains matter—such as the design of the 350-ton fitting-out crane at Philadelphia—which has not yet been made public, so recent in design and construction are they. Looking again at the other side of the ledger we find that although the article on Disposal of City Refuse has been expanded by a third it fills only two pages. This seems out of proportion to the space given to other subjects, besides which the informa-

tion given is not strictly up to date. Such unevennesses and deficiencies as have been mentioned are to be expected where so many men go to make up a book of such wide field as to preclude one man knowing all the subjects covered. At the same time there is no doubt that this multiple-control, so to speak, is eminently satisfactory in producing so many sided a book, which improves with every edition.

The staff of associate editors now numbers 18, the two new men already mentioned having been added. There have been three other changes in associate editors, Walter L. Webb, Ruldolph P. Miller and Frank P. McKibben having withdrawn and their places having been filled by Fred A. Barnes, Herbert F. Moore and Frank A. Constant. The corresponding sections are on Steam Railroads, Materials of Construction and Steel Structures.

Those interested in the art of book reviewing may wish to study two types of reviews followed in the case of the first edition of the "pocket book," the exhaustive and the summary. The notice in *Engineering News* (Feb. 11, 1911) filled ten columns, of which two were general comment and characterization and eight were a detailed examination of the contents of the volume, all by the editorial staff. The *Engineering Record* notice, only two days later, was a column and a half long, with a critical middle paragraph in the form of an editorial composite of opinions from six unnamed engineers to whom the book had been sent for report on designated sections.

Building the Pacific Railway

BUILDING THE PACIFIC RAILWAY: The Construction-Story of America's First Iron Thoroughfare Between the Missouri River and California, etc.—By Edwin L. Sabin. Philadelphia and London: J. B. Lippincott Co. Cloth; 5 x 8 in.; pp. 317; illustrated. $2.

How the first railway to the Pacific was located and built and how the conflict between North and South determined against the Southern route, although engineers had reported it to be the more economical, is told by Mr. Sabin in this book. The volume records the financial and engineering history of the Union Pacific and Central Pacific Lines, which met at Promontory Point, on the Great Salt Lake in 1869, completing railroad connection with the Pacific Coast in six years instead of the fourteen years allotted by the Congressional land grants. The foresight of engineers Judah and Dodge, and the remarkable location work carried on by their forces are shown throughout the book.

Since about 1830 routes had been proposed on locations which now approximate the lines of the Northern Pacific, the Santa Fe, the Southern Pacific, and the Union Pacific from Omaha westward, up the valley of the North Platte. Previous to the passage of the Pacific railroad "Act of 1862," granting bond issues and lands to construct a line from the Missouri River to the Pacific Coast, reconnaissance surveys had been made by Grenville M. Dodge, later chief engineer of the Union Pacific, and by Theodore D. Judah, later chief engineer of the Central Pacific. Construction of the Central Pacific, striking eastward toward the crossing of the Sierras by the Dutch Flat and Truckee route, and construction of the Union Pacific westward from Omaha both started in December, 1863. Mr. Sabin tells how construction was rushed by both companies, spurred by land grants and the prospects of the business of the valley of the Great Salt Lake. There is recorded the grading and track-laying records made by Charles Crocker of the Central Pacific and "Champion Track-Layer" Jack Casement of the Union Pacific, until the lines finally met at Promontory Point, Utah, May 10, 1869.

Legislation, financial history, and organization are dealt with at length in telling of the work of Stanford, Huntington, Durant, Dillon, Oakes Ames, the principal promoters and organizers of the two companies. While the volume contains much of interest to engineers, it is not an engineering book and unfortunately has some obvious errors, such as reference to grades of 40 per cent. However, the author recognizes the remarkable location work, carried out under great pressure from headquarters and most disadvantageous conditions after construction had started. He says: "There was little opportunity for revision or back-tracking. It is remarkable that such work has stood the test of time, but it has been little altered."

Hints for Forming and Using Libraries

THE BUSINESS LIBRARY: What It Is and What It Does—By Louise B. Krause, Librarian, H. M. Byllesby & Co. San Francisco, Cal.: Technical Publishing Co. Cloth; 5 x 7 in.; pp. 116; illustrated.

Engineers, manufacturers and business houses who have or ought to have a library, even though it be small, would profit by this concise little book. After chapters on what the business library is or may be the author takes up periodicals, public documents, trade catalogs, classification and cataloging, mechanical equipment of the library, reference books and last, but by no means least, qualifications essential to the business librarian. The small list of general reference works and the brief reference lists at chapter ends are useful.

Research and Invention

THE OUTLOOK FOR RESEARCH AND INVENTION: With an Appendix of Problems Awaiting Solution—By Nevil Monroe Hopkins, M. Sc., Ph. D., Experimental and Research Engineer, etc. New York: D. Van Nostrand Co. Cloth; 5 x 8 in.; pp. 241; illustrated. $2.50.

Research workers, inventors, educators, manufacturers and certain government officials and legislators of the higher type will find stimulus and suggestion in this readable volume. There are chapters on the spirit of Research, Men of Research and Their Development, Indifference of the Past, American War Research, The Education for Research, Some Borderline Limits, Research in the Factory, The Making and Protecting of Inventions and a List of Practical Problems Awaiting Solution. Most of the book is written from the viewpoint of the chemist and physicist rather than of the engineer and nearly all the research problems listed are in the two fields named, but the author writes with knowledge and appreciation of engineering.

Water Powers of British Columbia

WATER POWERS OF BRITISH COLUMBIA: Including a Review of Water Power Legislation Relating Thereto and a Discussion of Various Matters Respecting the Utilization and Conservation of Inland Waters—By Arthur V. White, Consulting Engineer, Commission of Conservation; Assisted by Charles J. Vick. Ottawa, Can.: Commission of Conservation. Cloth; 7 x 10 in.; pp. 644; illustrated; folding maps in pocket.

Besides the general discussions and summaries to be expected in so comprehensive a survey this volume contains many data on power plants, built or proposed, references to undeveloped water powers, topographical information by main river basins and both stream flow and meteorological records—the last two including

many figures for the United States thought likely to be of value in British Columbia. The publication of the volume has been delayed—presumably by the war—but just how long is not stated. Data at least as recent as 1916 are included. Well selected engravings add to the interest of the volume, which is highly creditable to all concerned with its production.

For Designers and Users of Motor Vehicles

MOTOR TRUCK DESIGN AND CONSTRUCTION—By C. T. Schaefer, Consulting Engineer, Member Society of Automotive Engineers. New York: D. Van Nostrand Co. Cloth; 6 x 9 in., pp. 318; illustrated. $2.50

MOTOR VEHICLES AND THEIR ENGINES: A Practical Handbook on the Care, Repair and Management of Motor Trucks and Automobiles for Owners, Chauffeurs, Garagemen and Schools—By Edward S. Fraser, American Bosch Magneto Corporation; and Ralph B. Jones, Willys Overland Co. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 344; illustrated. $2.

The first of these books was written (or as the author says "compiled") for engineers engaged in the design and construction of motor vehicles, but "at the same time," the author states, "a general outline of the underlying principles is given for the student, commercial vehicle owner and operator who may desire to familiarize himself with the construction of the various units that make up the complete vehicle." The author frankly describes the book as a compilation, but it contains a considerable amount of explanatory and critical comment. The second book, as its sub-title says, is for owners, chauffeurs, garagemen and schools. Each book takes up a variety of types and makes of motor vehicle parts, and seems well designed to serve the needs of a large and growing class of possible users.

To Promote the Metric System

Under date of Jan. 15 the first issue of *The Weekly Metergram* appeared. It is published by the World Trade Club of San Francisco, which is promoting the adoption of the metric system in this country.

Maximum Rainfall at Boston

The larger part of the February *Journal* of the Boston Society of Civil Engineers (Tremont Temple, Boston; 50c. per copy) is devoted to a paper by Harrison P. Eddy on "Maximum Rates of Precipitation at Boston for Various Frequencies of Occurrence." The study covers records at Chestnut Hill beginning in 1879 and at the Weather Bureau gage beginning with 1891 and ending in both cases with 1916. Tables and diagrams accompany the text.

Census of Special Libraries

For the purpose of locating the various special libraries of the country and ascertaining the lines which each covers, data on the subject are being collected by William F. Jacob, chairman, Library Census Committee, Special Libraries Association, General Electric Co., Schenectady, N. Y. The committee desires information under the following seven heads: (1) Name of institution. (2) Name by which library is known. (3) Name of librarian or custodian. (4) Can it be classified as any of the following: financial, business, legal, engineering or technical; institutional, municipal, reference, agricultural? (5) If not, how can it be classified? (6) Does it serve a special clientele? (7) Would your librarian be willing to assist other special libraries to a reasonable extent?

A New Technical College Paper

Under the title *The Tech Engineering News* there was started in February at the Massachusetts Institute of Technology a "Professional Journal of the Alumni and Undergraduates" of the institution named. It will be issued monthly from Cambridge (10c. per copy; $1.00 a year).

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

THE ALL-AMERICAN CANAL: Report of the Canal Board, Dr. Elwood Mead, W. W. Schlecht, C. E. Grunsky, on A Canal Located Entirely Within the United States from the Colorado River at Laguna Dam into the Imperial Valley, California; Together with the Report of the Engineer in Charge of Surveys and Examinations, Porter J. Preston—Washington, D. C.: Department of the Interior. Paper; 6 x 9 in.; pp. 95; folding maps.

THE ARTESIAN WELLS OF MONTREAL—By C. L. Cumming. Ottawa, Can.: Geological Survey. Paper; 6 x 9 in.; pp. 153; illustrated.

COEFFICIENTS OF DISCHARGE OF SEWAGE-SPRINKLER NOZZLES—By Frederick W. Greve, Jr., Assistant Professor of Hydraulics, School of Civil Engineering, Purdue University, and W. E. Stanley, Recently Instructor in Hydraulics, School of Civil Engineering, Purdue University, Lafayette, Ind.; Engineering Experiment Station, Purdue University. Paper; 6 x 9 in.; pp. 28; illustrated.

COTTON WAREHOUSE CONSTRUCTION—By Robert L. Nixon, Assistant in Cotton Marketing. Washington, D. C.: United States Department of Agriculture. Paper; 6 x 9 in.; pp. 38; illustrated.

THE EFFICACY OF EXISTING MEASURES FOR THE PREVENTION OF DISEASE—BY George A. Soper, Ph.D. Reprinted from "Journal American Medical Association." New York City: The Author, 130 W. 57th St., New York City. Paper; 6 x 9 in.; pp. 14.

Notable among other things for its definition of sanitation and its classification of 17 specific measures for combating disease, of which 4 come under sanitation, 7 under board of health work and 6 under personal precautions.

EFFICIENT BOILER MANAGEMENT: With Notes on the Operation of Reheating Furnaces—By Chas. F. Wade, A. M. I. E. E., Boiler and Fuel Economy Specialist. New York and London: Longmans, Green and Co. Cloth; 6 x 9 in.; pp. 266; illustrated. $4.50 net.

British boiler room equipment and practice is outlined from the viewpoint of efficiency. Save for two pages at the end, coal is the fuel considered. The book throughout seems to be within the ken of the average boiler room superintendent, and much of it could be read with profit by any intelligent boiler room man.

EXPERIMENT STATIONS OF THE BUREAU OF MINES—By Van H. Manning. Washington, D. C.; Bureau of Standards. Paper; 6 x 9 in.; pp. 106; illustrated. 25c. from Superintendent of Documents.

THE HOUSING SITUATION IN ENGLAND AND THE UNITED STATES—By F. T. Miller, President F. W. Dodge Company. New York. Paper; 6 x 9 in.; pp. 30.

MODERN PRACTICE IN THE CONSTRUCTION AND MAINTENANCE OF RAIL JOINTS AND BONDS IN ELECTRIC RAILWAYS—By E. R. Shepard, Associate Electrical Engineer, Bureau of Standards. Washington, D. C.: The Bureau. Paper; 7 x 10 in.; pp. 131; illustrated.

MODERN ROADS—By H. Percy Boulnois, M. Inst., C.E., F.R. San. Inst., F. San. Inst., Etc. London, Eng.: Edward Arnold. Cloth; 6 x 9 in.; pp. 302; illustrated.

MORTALITY STATISTICS, 1918—Washington, D. C.: Bureau of the Census. Paper; 9 x 12 in.; pp. 92.

Made up wholly of tabular matter giving "some of the most important" mortality figures for the registration area, which in 1918 included 77.8 per cent of the estimated population of the United States.

NEW YORK INDUSTRIAL COMMISSION, Report, 1918—Albany, N. Y.: New York State Department of Labor—Cloth; 6 x 9 in.; pp. 261.

OFFICIAL YEAR BOOK OF THE COMMONWEALTH OF AUSTRALIA: Containing Authoritative Statistics for the Period 1901-1917, etc.—By G. H. Knibbs, C.M.G., Commonwealth Statistician, etc. Cloth; 6 x 9 in.; pp. 1246; illustrated.

ONTARIO PROVINCIAL BOARD OF HEALTH: Report, 1918—Toronto, Can.: The Board. Cloth; 7 x 10 in.; pp. 210; illustrated.

POPULAR OIL GEOLOGY—By Victor Ziegler, Professor of Geology and Mineralogy, Colorado School of Mines. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Flexible Cover; 5 x 7 in.; pp. 149; illustrated. $2.50.

Contractors or "Large" Contractors For Highway Work?

By Dana W. Robbins
Utica, N. Y.

This article presents the "other side" of the highway contracting case.

Opinion has recently favored the letting of contracts in long stretches to induce large contracting organizations to enter the highway field. "Engineering News-Record" itself has taken that view.

Both Mr. Robbins and this journal would welcome discussion on the points discussed in the article.—Editor.

DURING the early months of 1919 it was frequently asserted, in effect, that highway construction was about to be revolutionized. Large construction firms were entering the field and were to put "model" costly plants on the work—plants capable of building roads at the rate of a mile a week, etc. There was, and still is, an agitation for very long contracts, for it was evident that with the progress expected a five- or six-mile job would be only a small part of a season's work. These assertions were often accompanied by a few allusions to the delinquency and general unfitness of the "old-timers" who to date have built all the roads the country has.

These "old-timers" had generally reached the conclusion that highway construction was a "small-contractor" proposition; and by "small" is meant not necessarily a contractor who can finance only a small job, but a contractor who takes only work to which he can give his own personal attention and supervision. They believed this for a very simple reason, viz., that each piece of work required constant, resourceful supervision of a kind they were unable to hire. The work was seasonal work and the keeping of high-priced men on the payroll during winter months ate up much of the profits that close competition allowed. The contractors themselves could supervise only a very limited number of jobs. In fact any increase over one contract meant less attention.

There had been in New York State one very pretentious effort to do road work on a large scale, and there had been two or more efforts at large expansion by firms already successful on a smaller scale. All these ended very disastrously, principally for the reason given. However, with great impetus given to road-building with post-war conditions, and highway estimates of $30,000 to $50,000 and more per mile, these contractors were confronted with so many new problems that they were entirely willing to be shown, and were half inclined to think they would be.

The results of the past season's efforts would seem to be somewhat reassuring to them. The "model" plants were not models and showed little if any more work than was customary during a season. The large contractors made little if any more progress than that averaged heretofore. It is rumored that profits were not up to expectations, even at the greatly increased prices.

Is the problem of increased construction organization to meet increased demands—if there be such a problem—best relieved by offering inducements to large construction firms which other contractors would be unable to accept? Or is it best relieved by removing all unfair, one-sided clauses from specifications, and then leaving it an open game where the greatest number can compete on terms of equality?

Roadbuilding Plant

There seems to be an intimation in the discussion of recent months that contractors previously engaged in highway work have not been properly equipped. Considered in general, such an idea is so far astray as to be absurd. They have bought lavishly, have paid for all the machinery, manufacturers' experiments, and have gone on the rocks more frequently as the result of plant rather than the want of it. They may be depended on in the future to buy any equipment offered, provided they are reasonably satisfied of real economy in so doing.

Considerable stress has been laid of late on elaborate "co-ordinated" plants—which, evidently, during the past season did not always co-ordinate. There is no part of these plants that is especially new other than some new labor-saving devices such as finishing machines, sub-graders, etc. It would be a great mistake, however, to assume that because industrial railway, for example, is not found on every job, the contractor is ignorant of its merits or unable to get it. He probably knows all about it.

In vast areas of the country suitable materials can be crushed along the road at various points, excavation is frequently in rock, grades are high, and conditions in general are such that plant must be an assembly of whatever units appear to be desirable, as many as possible from the contractor's stock, and it will be the task of the superintendent to keep them moving whether they co-ordinate at all times or not.

Just what is new about this co-ordination, and who discovered it so recently? It has been suspected among road contractors for some time that if a mixer is capable of handling a certain amount of material daily it cannot be run to capacity unless some agency gets the material there at the necessary speed. Also that it would be necessary for the crusher to turn out that much material, or more, daily, and that the quarry would have to keep the crusher supplied. If anybody has discovered how to keep these things all moving properly, put culverts in, prepare the grade and do many other things, then he has made a real contribution to highway construction. It happens occasionally, but if things are not co-ordinating don't assume that the contractor had overlooked a few links in the chain. They may be twisted, but he knows they are, and that some day the other fellow's chain will kink, no matter who he is.

Finances

No contractor or firm should undertake any more than can be financed properly. If a contractor confines his efforts to work that he can finance properly he is just as well equipped, financially, for that work as anybody could be. He could extend his operations and do more work if, by a general revision of one-sided contracts, public officials would reassure the banks and business men of the country who have lost confidence in highway work as a business proposition. There are today many banks that will not lend a dollar to a high-

way contractor because they are convinced that the work is very hazardous and that the question of profit is dependent not only on the contractor's ability, weather conditions, etc., but also on the decisions of the engineer or inspector, to whom the contract as customarily drawn gives almost unlimited power. A start in dispelling this impression could be made by removing from all contracts clauses which courts have already held are inequitable. The contractor—and especially the small contractor—needs his money promptly, and he can use the money by prosecuting the work more rapidly or by extending his operations.

Supervision

It is a mistake to assume that the matter of supervision can be solved by having a very large contract and a correspondingly high-priced man to oversee it. A very long contract can progress properly only by having a number of outfits at work, and each outfit will require just as good a man as a separate piece of work would. There is no other line of construction work requiring more constant attention and rearrangement of forces than road work, especially in rough country where many items of work are progressing. Rainy days and other troubles disarrange all schedules and delay progress, yet frequently work of some sort must be provided to keep labor contented. It is at such times that resourceful supervision counts, and it counts only if it is right there at starting time in the morning.

It is very doubtful if, on the whole, the large contractor can secure supervision that will excel, or even equal, that given by the smaller contractor who is spending his own money and reaping the rewards or paying for failures. There is nothing very technical about road work, and a natural ability and resourcefulness, and money-making instinct are worth much more than an engineering education. In fact highway engineers who have become road contractors have not been successful, as a rule, in New York State.

It is very probable that in spite of labor conditions and of last season's experience road contractors can make greater progress than that hitherto averaged, in just the proportion that they are paid for doing so and in much the same way that speed was secured in war enterprises. If cost is still a consideration, however, it would seem to be good judgment to ask any firm to demonstrate that it is a permanent feature of the enterprise before taking any steps that would result in shutting out the competition of those already in the business. There should be no difficulty at the present time in any firm's securing contracts up to $300,000 or $400,000 each. A contract of this size should be ample to demonstrate any economy of methods or increase in speed. Any plant investment on a job of this size could hardly equal, in proportion, that made by any "old-timer" in the past, and there is no business in the United States today where the outlook is more favorable for the continued use of plant than in road work.

Several states have either organized construction forces or are considering doing so. It is difficult to see just how this plan is to increase either rate of construction or efficiency. Rate of construction depends largely just now on the supply of "floating" labor which can be secured without raising the price to unreasonable limits. The state as a contender for this limited labor would not increase its efficiency, judging by past standards.

There appears to be a country-wide demand, coming from everybody except labor interests, for less government activity and the return of business to private control. If the arguments advanced are sound in regard to the railroads, steamship lines, shipbuilding, lumber operations, etc., why not in regard to the construction of roads? The attitude of labor in this matter should be pondered by officials who are contemplating any such move.

The contract system under which public work is largely carried on at present has withstood all assaults and will continue to do so until some substitute better than anything advanced to date has been devised. It has done so because of its obvious merits which far outweigh its defects. The greatest of these merits are the facts that it is based on open, competitive, bidding and that the success of any man is more largely dependent on his own ability and efforts than on any other factor.

That being the case, any action which will curtail, to any degree, this open feature of the work will, in the end, only bring discredit on the system. There have been and will be those entering the business who are not fitted in some essential way for the work. Likewise they can be depended upon to drop out in due time. To argue that any special line of action is necessary to guard large construction firms against this evil is to contend that the eminently fit must be protected from the competition of the unfit—which is an absurd proposition entirely opposed to the spirit in which the contract system was built up and upon which it stands. To this extent highway officials should disregard entirely the statement recently submitted by the Associated General Contractors of America and proceed on surer ground

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Abnormal Death Rate in 1918 Due to Influenza

Nearly 18 deaths per 1,000 population (actually 17.97) occurred in the registration area of the United States in 1918, according to the Bureau of the Census. This is the highest death rate on record since the Census Bureau began the compilation of annual mortality statistics. The high figure is due to the pandemic of influenza which together, with all forms of pneumonia, caused 32.4 per cent of all the deaths recorded in the registration area in 1918. The total number of deaths in the registration area was 1,471,367. The typhoid deaths in the registration area totaled 10,210, or 12.5 per 100,000. The corresponding rate in 1910 was 34.9. The death registration area in 1918 included a population of 81,868,104, or 77.8 per cent of the estimated population of the United States. More detailed figures for influenza and pneumonia, as given out by the Census Bureau are: "Of the total deaths 477,467, or over 32 per cent were due to influenza and pneumonia (all forms), 380,996 having occurred in the last four months of the year during the influenza pandemic. The rate for influenza and pneumonia (all forms) is 583.2 per 100,000. Influenza caused 244,681 deaths and pneumonia (all forms) 232,786, showing rates of 298.9 and 284.3 per 100,000, respectively, these being the highest rates which have ever appeared for these causes. The rate in 1917 for influenza was 17.2 and for pneumonia (all forms) was 149.8. In fact the difference (416.2 per 100,000 population) between the 1917 and 1918 rates corresponds with the excess mortality which occurred in the last four months of the year from the influenza pandemic."

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

"A Word of Caution"

[The situation is the one dealt with in the news section of the Feb. 26 issue, p. 442, where was reprinted the "Word of Caution," a pamphlet distributed to the American Society of Civil Engineers, urging the defeat of the "comprehensive organization" recommended in the Joint Conference Committee's report.]

Sir—I believe that the proposed warning to the members of the society is most timely. It would certainly detract from the dignity of the society to embark on a political field, such as is proposed in the questions which are to be submitted to members. The whole movement seems to me to be of a hysterical nature and it is hoped that all of the conservative members will see the danger as well as you and your friends have seen it. Our society certainly does not wish to become a lobbying body instead of the great technical society which it is now and has been heretofore.

RALPH MODJESKI,
New York. Consulting Engineer.

Professional Plagiarism

Sir—In the article on "Professional Plagiarism" in your issue of March 4, p. 477, the author finds fault with the use of books in writing papers, etc. It is all done very nicely and apparently is very convincing. There is one question, however, which I wish to ask. Where did he get the information for the paragraph on the cubic equation of Tartaglia? Is it possible that he had before him Ball's "History of Mathematics," or perhaps Cajori's "History of Elementary Mathematics," p. 225, and there found the source of inspiration for the article?

We are all dependent upon books, some people more so than others, and it seems to me that the best of us ought to be careful how we find fault with the worst of us.

EDWARD CAMPBELL.
Swedesboro, N. J.

The Decadence of Inland Water Transport

Sir—I have read with interest the series of articles on the future of inland water transportation, for I was 21 years with the Government upon river and harbor work and formulated a number of projects for both inland waterway development and cost ports.

One statement that you have probably observed in the official reports made by the District Engineers to the Chief of Engineers, U. S. Army, is that freight rates have been lowered such and such a per cent due to inland waterway improvements. This percentage is quoted year after year in the reports, but if the statement be analyzed it will be found in most cases that this change took effect many years ago when certain localities or cities, by their location, were favored with a special port rate. In my opinion, there are very few cases where freight rate reductions have been made due to waterway improvements since authority was given to the Interstate Commerce Commission.

I heartily indorse the statements and opinions of your articles on water transport. For many years before retiring from the U. S. Engineer Department I could only half-heartedly become interested in certain problems which were given me to work out upon improvements on inland rivers, for I realized all the time the great change from what formerly existed, and the decadence of water transportation upon the shallow rivers and canals.

E. R. CONANT,
Brunswick, Ga. Consulting Engineer.

Microscopic Composition of Earth Dam Cores

Sir—In reading the article "Study of Pressures in Hydraulic Dam Cores," in your issue of Dec. 25, 1919, p. 1040, I have wondered if a microscopic examination of the core material might not throw considerable light on its tendency to slide.

I am led to make this suggestion from a casual observation of many vertical cut banks in this state which are stationary, as compared with many hills of low slope which are sliding. Neither the nature of the material nor its water content appears to account for the slides, hence I am led to believe that the physical form of the particles and the position in which they are deposited out of the water may have a good deal to do with the drainage of the core and also the tendency of the material to slide.

Great Falls, Mont. J. C. DOW.

Engineers To Design Industrial Buildings

Sir—The writer has been very much impressed by your comment on the statement of the State Art Commission of Pennsylvania, on the proposed Delaware River bridge, in the Jan. 29 issue of *Engineering News-Record*. Every engineer who takes pride in his profession, every engineer who does not believe in being a wage slave, but who looks forward to the happy times when he will be able to practice his chosen profession independently, must do his best to overcome the ever-growing menace to the profession. Architects are designing reinforced-concrete buildings with "cement floors as per code." Now bridge designing is being usurped from the good-natured engineer.

Architects are organizing everywhere and their influence is being felt. The public is educated to look to the architect to design anything that is to stand up on the ground, no matter for what purpose. That architects are constantly bringing forward the absurd statement that an engineer is not trained to design, but merely figure out stresses.

It is true that an engineering graduate is not so qualified. But does a professional man's training start and stop at the college gates? Is not the engineer, who makes structures his specialty, with his broad knowledge of mechanical principles, better equipped to study and master the demands of serviceability and utility of an industrial building than an architect?

Engineers are clamoring for a better standing before public opinion. It is time, then, that the engineer should consider his solemn duty to do something more conspicuous than figuring. The interest of the public will be better served if an engineer is charged with the design of industrial building with architectural assistants, rather than that an architect be charged with the design, having engineers as assistants. But how are we to overcome the prejudice of the public?

Architects are working towards their end with organization and mighty effort. We can only uphold our end with organization and counter effort. The architects are constantly spreading the malicious propaganda that nobody but an architect is qualified to design a building of any kind, and they are succeeding in putting restrictions as to who shall be called architect. What are we going to do about it?

New York, N. Y. MISSAC THOMPSON.

Economy of Temporary Structures

Sir—Your editorial of Feb. 12, 1920, speaking of the special importance likely to be given to economy in bridge construction in the future, brings to mind a feature in present-day practice in highway bridges which in many cases seems to be the very opposite of economy and good business principle. I refer to the present tendency in many instances to build expensive permanent bridge structures in isolated localities apparently for no other reason than to satisfy the ambition to always build the best.

We do not in any sense advocate the building of cheap or temporary structures where conditions will warrant good permanent construction, but we think there are many cases where, if those who pay the bills would make a few simple calculations of interest on investment and the like they would at once see that it would be better business to build a wooden bridge having a life of 10 to 15 years and renew it periodically rather than spend four to ten times as much on a handsome permanent structure that must always "blush unseen," like the famous flower in Gray's elegy.

With interest rates at 5 per cent it is easily shown that we would be warranted in expending one third the cost of a permanent structure on a temporary structure that would last 9 years; about one-half the cost of a permanent structure on a temporary structure having a life of 14 years. I believe there are many cases in sparsely settled towns struggling with the bridge problem where a little light given them on the possibilities of wood construction would be an agreeable surprise.

Below is a table I worked out for my own use, showing how much per $100 cost of permanent structure may properly be spent on a temporary structure of a given life to make the two propositions equal on a strictly investment basis.

PERMISSIBLE EXPENDITURE FOR TEMPORARY STRUCTURES

For various lengths of life of temporary structure. Amounts given per $100 of cost of permanent structure.

Life in Years of Temporary Structure	Interest Rates 4 Per Cent	5 Per Cent	6 Per Cent
3	$11 10	$13 62	$16 04
4	14 52	17 73	20 77
5	17 81	21 65	25 26
6	20 97	25 37	29 48
7	24 01	28 93	33 48
8	26 94	32 30	37 27
9	29 75	35 54	40 79
10	32 45	38 61	44 14
11	35 03	41 52	47 35
12	37 50	44 31	50 30
13	39 91	46 95	53 12
14	42 20	49 50	55 77
15	44 48	51 90	58 30

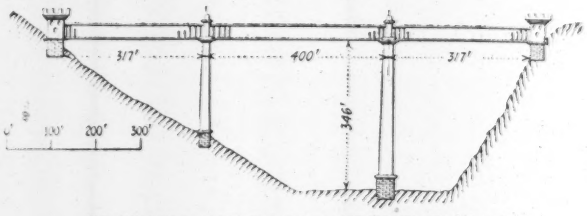
I am aware that there may be many elements enter a given case that will render impracticable the strict application of the interest and investment theory, but when each is given its proper study I believe there will be found many instances where the small wooden bridge should be given prominence.

Skowhegan, Maine. E. E. GREENWOOD.

Needed: A History of Engineering

Sir—Referring to the article by R. Fleming on the need for a history of engineering, published in the *Engineering News-Record*, Feb. 12, p. 322, and the item "Telford's Proposed London Bridge," the following information relative to a proposed high level bridge on the Mexican Railway, which was surveyed, located and built by Captain Andrew Talcott, an eminent American railroad civil engineer, may be of interest.

One of the difficulties encountered in the survey of this railroad was the crossing of the deep *barranca*, between Cordoba and Orizaba, formed by the Rio de Metlac, the chasm being 1,085 ft. wide at the grade line which was 346 ft. above the stream.



PROPOSED MEXICAN RAILWAY BRIDGE

An estimate of cost for a single-track, tubular bridge 1,034 ft. long was submitted under date of Manchester, England, Nov. 26, 1858, by William Fairbairn, the well-known English engineer, who proposed a central span of 400 ft., and two side spans, each 317 ft. long.

The cost of the iron work delivered in Liverpool was estimated as follows:

One 400-ft. span, 1,250 tons at $106	$132,500
Two 317-ft. spans, 1,433 tons at $107	153,333
Cast-iron towers, 1,666 tons at $45	75,000
Total	$360,833

Captain Talcott's estimate for the completed bridge was $1,200,000, so that a large allowance must have been made for the transportation and erection of the iron work, as well as for the necessary masonry foundations and ornamental towers.

The bridge was never built, but a few years ago its erection was seriously considered, but has been deferred indefinitely, due to the fact that, after long deliberation, it was considered that a bridge of such magnitude would be very easily destroyed, with, of course, disastrous consequences.

Buffalo, N. Y. EMILE LOW.

Track and Locomotive

Sir—The editorial on this subject in *Engineering News-Record* of Feb. 26, p. 403, seems to give the impression that the serious relation of locomotive counterbalancing to track troubles is a new discovery set forth in the report of the Track Stress Committee. This no doubt is unintentional, for as a matter of fact this relation has been the subject of investigation and discussion by civil and mechanical railway engineers during the past twenty years or more. In spite of all this, it has been as difficult to get well balanced locomotives as to get well made steel rails.

Prominent in the experimental investigations was the work of Dr. W. F. M. Goss in passing copper wire under the driving wheels of a locomotive on a testing plant and noting the varying compressions or reduction in area due to the varying load during the revolution of the wheels. Rails damaged by badly counterbalanced engines have been a track trouble for many years.

One step toward improvement in this direction was the introduction of four-cylinder balanced compound locomotives. These were much in vogue at one time, but are not much used on American railways in these days. They were, and probably are, more common on European railways. In regard to the weight of reciprocating parts, the relative lightness of such parts in European locomotive design has been commented upon many times.

While the evil effects of defective counterbalancing have been known for a long time, comparatively little has been done to ensure good counterbalancing. It is to be hoped that the report of the Track Stress Committee may lead to some definite improvement in this direction.

Chicago, Ill. "RAILWAY."

A Layman's Viewpoint of the Proposed Hudson Vehicular Tunnels

Sir—The vehicular tunnels under the Hudson River (see *Engineering News-Record*, Feb. 19, p. 357), having been talked of for many years, now seem to be approaching the construction stage. It is perhaps presumptuous for one who is not directly identified with the civil engineering profession to make remarks not entirely of a congratulatory character upon reading the reports and attending the public hearing of an enterprise which presumably requires the utmost exertions of the most talented civil engineers of the country. Enterprises involving huge expenditures of public funds are now becoming so great in number, that the layman, being the source of supply of these funds, is becoming very alert as to how, when and where these funds shall be spent. So, therefore, you gentlemen of the civil engineering profession can perhaps anticipate that the general public will exhibit a much greater interest in your efforts than has previously been the case. Broadly speaking, it is presumable that this increased public interest will be very helpful in many instances, and very irritating in others.

The average layman with any sense of proportion realizes that a profession as theoretical and empirical as civil engineering frequently produces diverse opinions in the minds of the most competent exponents of this profession. So, therefore, if he is wise he will not pay much attention to disagreements between the members of the profession as to the technical details of construction of such an enterprise as the vehicular tunnels. His real interest, however, is directed toward two things: First, will the tunnels be beneficial when they are built; and, second, how much will these tunnels cost? When information is furnished on these two points, it naturally leads him to the most important inquiry, which is: "Will the service rendered by these tunnels, as designed, be most productive for the number of dollars invested in the building of them?"

It is reasonable to assume that the layman will be very severely criticized and impatiently treated if he injects his opinions into technical details, but it is also perfectly patent that the exponents of the civil engineering profession who designed such apparatus will receive short shrift from the public if in its mind the results of the engineers are not adequate either from the economic or economical standpoint. It is believed that the general public as a whole holds the civil engineering profession in high esteem, but in my own humble opinion the attitude of the general public will change with the utmost rapidity to the other direction, should the profession show itself weak, and as the layman knows comparatively little of the technical details of such an enterprise, he is very prone to judge the ability of the persons responsible for this technical detail by the conclusion he reaches on the things which he, as a layman, is very familiar with, in such an enterprise.

The writer assumes that the engineering talent which has been associated with the tunnel enterprise for the last three years has among its members some of the best known civil engineers in the country, and that there is a strong contradiction of opinion between these gentlemen as to how the tunnels shall be built, but the outstanding point to the layman (or rather that portion of the general public which will directly utilize these vehicular tunnels, and by that I mean not only the transportation interests but also the merchants whose freight will move back and forth through these tunnels), is, despite all this brilliant talent working with monumental effort through several years, that none of it seems to have adequately grasped the very potent, elementary, essential feature, and that is, the volume of traffic which will go through these tunnels.

If the volume of traffic was exceedingly small, the huge cost of these tunnels would make it obviously undesirable to build them, and conversely, if the volume of traffic is very large, the revenue derived therefrom will justify a very large expenditure of money for construction purposes. The engineers went painfully and carefully into minute details in an endeavor to find out what the present traffic was across the river, and, using that as a basis, estimate that these two-line tunnels will reach their maximum capacity 17 years from now.

To one who is familiar with the freight situation in the Port of New York such a statement can, under the most generous impulses, be considered as the result only of mental exhaustion, senility or a foresight limited to such an extent that no faith or confidence could be reposed in persons reaching such a conclusion. This statement is a bitter one, but what a dreadful thing to contemplate that all these talented engineers, striving to accomplish good, should so far underestimate the absolute essentials of the traffic of the Port of New York. As a matter of fact, it could be very easily shown by inquiry of the traffic departments of the various large industrials and merchants in New York City, that if the vehicular tunnels were available the volume of freight which would then be handled from the Jersey terminals rather than over the piers in New York City, would furnish a sufficient amount of traffic to more than utilize the maximum capacity of these tunenls in less than six months' time from the date of their opening.

It is perfectly apparent to any observer that the largest proportion of freight which is received in the City of New York comes from the railroads which terminate on the Jersey side of the Hudson, and anybody who is familiar with freight handling knows that, provided adequate means of getting across the river could be furnished for vehicles which would permit their passage in a few moments, an enormous amount of freight which is now handled from the New York City piers after having been lightered from Jersey, would be handled direct from Jersey, because of the greater expedition and actually decreased cost

of transportation through the elimination of waiting time at the piers.

The writer has no knowledge of the cost of the three-line tunnels, but unless the cost is utterly disproportionate, by all means we should have the three-line traffic and even it would reach its maximum in a year's time. The validity of this statement can easily be determined by a short investigation conducted among the traffic managers of the merchants and manufacturers situated in New York City, finding out their present tonnage, and how much of it would come through these tunnels if they were available now, without even taking into account the enormous increase in tonnage which occurs every year in the Port of New York.

The writer has made a very bitter statement as to his opinion of the engineers responsible for the information that the two-line tunnels would reach their capacity in 17 years from now, but he did so with the belief that anybody who perpetrated such an outrageous error after many years of training and experience should pay very severely for his fault.

The point which next arises is: If these gentlemen have so dreadfully miscalculated the traffic which will utilize the tunnels, how much confidence may we place upon their technical decision as to how the tunnels are to be built? This matter is of such great importance that the writer hopes that through your efforts a movement will be started to investigate what the traffic possibility will be for these tunnels by the time they are ready, and if it develops that the engineers are radically wrong in their conclusions of volume of traffic which will be offered for these tunnels when they are opened, undoubtedly the general public will take steps to see that such mistakes will not be duplicated in other portions of this enterprise.

New York City. GEORGE H. PRIDE.

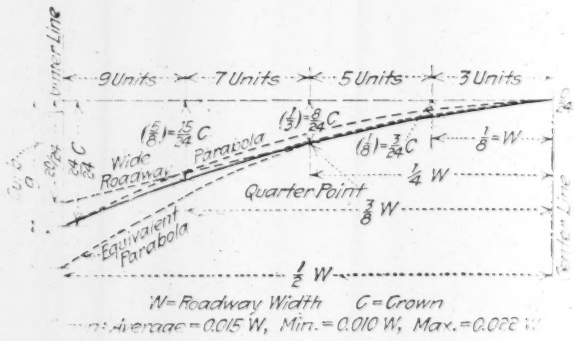
Cross-Sections of Roads and Streets

Sir—A suggested cross-section of road made up of two plane surfaces appears in *Engineering News-Record* of Jan. 29, 1920, p. 227. Theoretically the suggestion is good in that it provides for increased drainage near the middle of the roadway and decreases the slope of the surface near the outer quarters of the roadway. In practice the curved surface proves to be more satisfactory. The arcs of circles on the parabolic form of curve are not the best types of surfaces for modern traffic. A modified form of curve is better.

The traffic tends to keep to the center of the road, because of the more comfortable (vertical) position of the vehicle, greater safety and usually cleaner conditions. After a light snowfall one may observe how little the traffic uses other than the middle strip of roadway. To accommodate the traffic which persists in doing this, the middle 6 ft. should be as flat (or horizontal) as possible in order to eliminate excessive wear (or cutting) occasioned by the inside edge of the vehicle tires. The gradual substitution of rubber tires reduces this wear to some extent. The middle traffic is always the fast-moving traffic and should be provided with a nearly level surface.

The side traffic is either stationary or slow moving and can travel on an inclined slope. The curved surface, because of its flatter slope near the center and its increased slope near the sides, facilitates drainage and tends to carry all debris to the gutter or roadway edge.

A modified form of curved surface, shown on the accompanying drawing, has been developed by the writer and adopted for pavements in the city of Chicago. It will be seen that the desirable flat surface along the middle is retained but the excessive slope at the outer quarters is very much reduced. Drainage is satisfactory because of the increasing slope toward the gutter or edge. The full crown is reduced 25 per cent. over the usual parabolic form. This form increases safety to traffic and increases width of "available" roadway, thus distributing traffic and increasing the life of the pavement.



NEW FORM OF STREET SECTION ADOPTED IN CHICAGO

The crown is easy to "lay out," the quarter point being one-third the crown below the center line grade. There is another practical reason for the popularity of the curved crown. Since traffic concentrates along the middle strip, this part receives the greatest wear. The lines of maximum wear are approximately two to three feet on each side of the center line of the road. By laying a straight-edge below the curved crown shown in the drawing it will be apparent that considerable wear will have taken place to even reduce the surface to a plane and still further wear to interfere with surface drainage. The form of curve shown is used for roadways up to about 50 ft. Wider roadways may have the outer quarters on a plane surface from the quarter point to the roadway edge or gutter, as indicated on the drawing. H. J. FIXMER,

Paving Engineer, Board of Local Improvements.
Chicago.

Designing Columns for Bending Moment

Sir—One of the time-consuming problems in structural design is the selecting of column sections for columns carrying combined direct load and bending. Recently in selecting a large number of such columns the writer used the following method, which is believed to be simpler than that ordinarily used. Starting with the usual formula $f = \frac{P}{A} - \frac{Mc}{I}$, change was made to the form

$$fA = P - \frac{Mc}{r2}$$

It will at once be seen that fA is the allowable load on a column for various lengths and is the quantity given in column tables. If, then, Mc/r^2 is computed and added to the direct load, the column tables in common use can be used for the case of combined direct load and bending. For use in practice the term c/r^2 is computed and

tabulated in the margin of the table giving the properties of column sections. (This quotient is the same as area divided by section modulus.)

A practical application of the above may be illustrated as follows: Let it be assumed that inspection indicates the desirability of using a 10-in. Bethlehem H-column at a point where a bending moment of 150,000 in.-lb. in the direction of the plane of the web must be provided for in addition to the direct load. The accompanying table will show the effect of the moment in a few such columns.

Column	c/r^2	Mc/r^2
10 H 49	0.270	40,500
10 H 54	0.268	40,200
10 H 59.5	0.267	40,000

Experience with the use of this method soon indicates the column which will probably be used for a given case, and Mc/r^2 is computed using the value of c/r^2 for this assumed section. If, however, a wrong section has been assumed the table shows that the value of Mc/r^2 given by the wrong section may still be used, as c/r^2 changes very slowly in a series of related columns. After computing and tabulating c/r^2 for all columns which are likely to be used, the design of columns carrying bending becomes as simple as the design of those carrying direct load only.

Cambridge, Mass. H. L. BOWMAN.

Advertise Engineering Service as Commodity

Sir—There are many engineers who do not receive adequate returns for their service, and there are some who cannot sell their service at all, for the simple reason that there is no demand for the product they have to sell. This lack of a demand for a product is peculiar not only to the engineering profession, but has been encountered in the sale of other products; and the lack of demand has been very successfully overcome.

For example, the California raisin growers found they were producing more raisins than there was any demand for. Some growers were not able to sell their products and the others were not getting a good price for what they sold. Raisins were a luxury; their greatest use was at the Christmas holiday season. How did these farmers overcome their difficulties? They co-operated as a body to meet conditions. Each year in their co-operative organization a certain amount of the returns from the sale of their products was pooled into a big advertising fund. Did they advertise that certain growers were experts, sincere in their work and could deliver a good product? No. They recognized that their difficulty was a lack of demand for what they well knew was a good product and they used this advertising fund to educate the public into demanding what they had to sell. They told the public how to use raisins—use them in bread, desserts, etc., to get them at local grocery stores and to use them daily as a food and not as a luxury. As a result of this advertising and in spite of the fact that they are continually growing more raisins each year, they are selling all of their product and selling it at a better price.

There are many other examples of an enormous demand for a product being thus created where formerly but a small demand had existed. Farmers have shown us that by co-operatively advertising on a big scale a demand can thus be created for what was once considered a luxury. Engineering service was never a luxury. Almost always it is used only as a necessity—when there is no way to avoid its use. Certainly a much greater demand can be created for it, so that the entire product of engineers could be sold, and at a much better price than now exists. By proper advertising on a big scale the public can be told, not that certain engineers are experts, sincere in their work and capable of delivering a good product, but of the benefits of engineering service.

The farmers had numerous local associations, but such associations, individually, were unable to finance the advertising necessary to create a demand. The engineers have numerous associations. By these associations pooling a part of their dues, and by a big percentage of individual engineers pooling a small part of their profits all for one big properly directed advertising fund, a real demand can be created for engineering service in general. Consequently all individual engineers will be able to sell their service and sell it at a better profit.

It is rightly unethical for engineers as individuals to advertise their service in competition with other individual engineers, but it certainly is ethical for all engineers to co-operatively advertise engineering service as a commodity and to co-operatively secure the benefits of an increased demand for this commodity. It is good business and numerous examples can be found of the remarkable results than can be obtained by such advertising. Engineering service is a commodity that can well be more widely used, but advertising is needed to create a wider demand for it.

Seattle, Wash. HORACE M. HOLMES.

Highway Location—A Fine Art

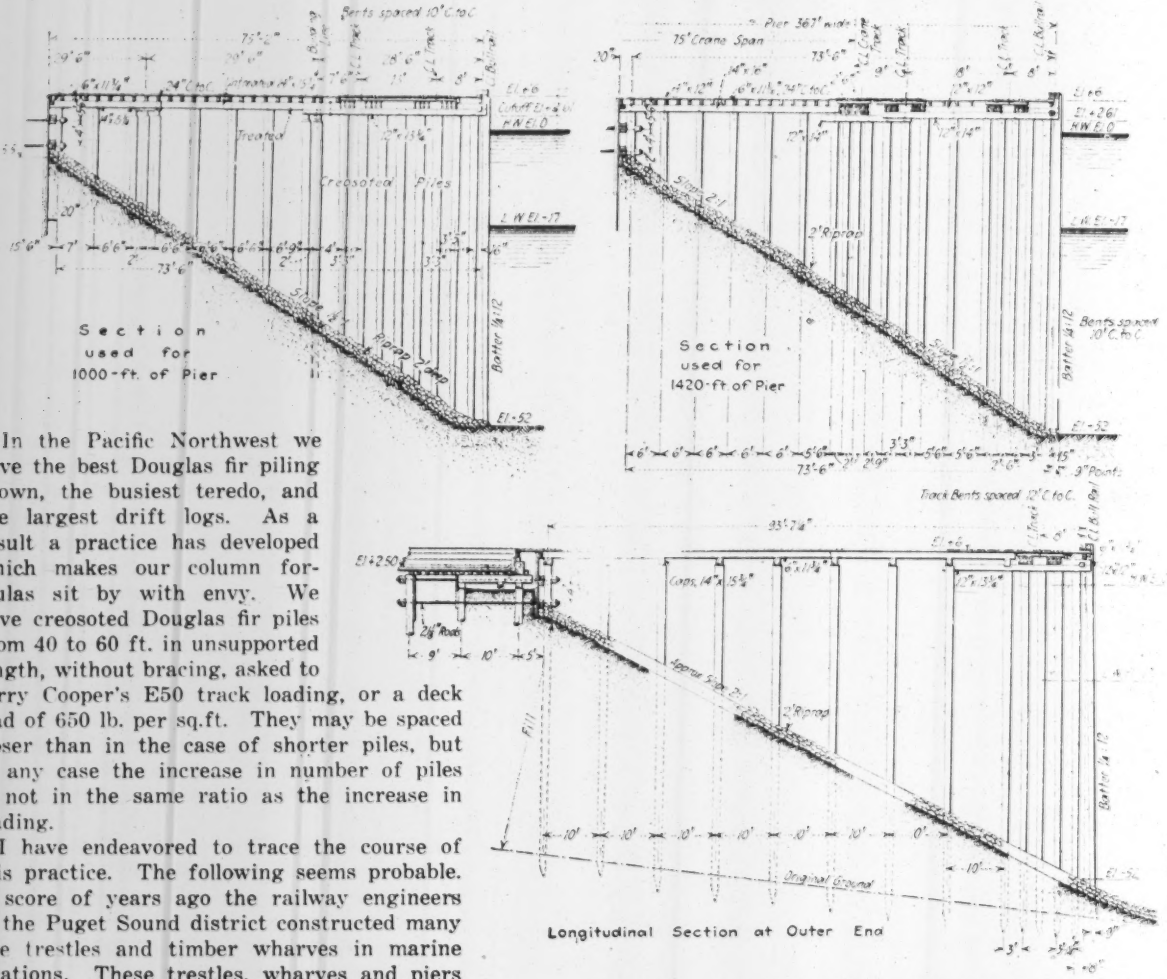
Sir—Mr. Syme's article, "Need for Economic Location of Highways," *Engineering News-Record*, Feb. 19, 1920, p. 383, is most timely. It expresses the wish of many highway locators. Highway location has been a special study of the writer for some years, and in an effort to collect a little data within the past two months he has had interesting experiences. Letters were addressed to several Western colleges having engineering courses, requesting available facts regarding local traffic records, etc., also regarding experiments made to determine cost of operation of 3-ton trucks on grades from 1 to 8 per cent. All replied that they had no traffic records or cost data. This would indicate that engineering schools are interested in the construction, and not the operation, of highways. There is little indication that trucks will be rated on a strictly ton-mile basis. The financing and operating conditions of motor trucks are vastly different from the railroads. The main highways are generally satisfactory; the trouble comes within city limits, motor truck garages and terminals. There is no available data to write a book on the economic location of highways, but conditions are now favorable for extensive experiments covering all types of motor vehicles and trailers. Any articles giving operating costs over different types of roads and varying rates of grade will fill a pressing need.

Railroad location due to rigid conditions is a science; highway location is a fine art.

Olympia, Wash. FRANK W. HARRIS.

What Will Long Piles Carry?

Sir—The condition outlined in this letter should be of interest to all structural engineers, who have heretofore met the common pile as a long column. Engineering practice is always changing, standardization to the contrary notwithstanding; generally progressing but occasionally retrogressing for a short time. In the case of a retrogression, a harking back to an old story is in order. A warning ten years ago does not necessarily mean that it is not needed today.


Bents spaced 10' C to C
Creosoted Piles
Section used for 1000-ft. of Pier
Section used for 1420-ft of Pier
Track Bents spaced 12' C to C.
Longitudinal Section at Outer End

SECTIONS OF NEW PIERS, PORT OF SEATTLE, ILLUSTRATING USE OF LONG PILES

In the Pacific Northwest we have the best Douglas fir piling grown, the busiest teredo, and the largest drift logs. As a result a practice has developed which makes our column formulas sit by with envy. We have creosoted Douglas fir piles from 40 to 60 ft. in unsupported length, without bracing, asked to carry Cooper's E50 track loading, or a deck load of 650 lb. per sq.ft. They may be spaced closer than in the case of shorter piles, but in any case the increase in number of piles is not in the same ratio as the increase in loading.

I have endeavored to trace the course of this practice. The following seems probable. A score of years ago the railway engineers in the Puget Sound district constructed many pile trestles and timber wharves in marine locations. These trestles, wharves and piers were thoroughly braced according to standard practice. Piles were creosoted. The load on piers was limited to 400 lb. per sq.ft. and never exceeded 500 lb. per sq.ft. These piers were so short that a yard engine was scarcely ever seen upon them.

A few years later the same railway engineers discovered that the bracing was no end of trouble, teredo would enter the holes bored for bolts, driftlogs became entangled and with the help of wave and tide pulled the bracing off, and finally the maintenance foreman howled his head off when bracing had to be removed in order to replace a damaged pile. Hence bracing is now out of style in marine locations. Batter piles have taken its place to some extent, but batter piles also have already been discarded by some engineers. This practice is no doubt justified for relatively light loads or shorter piles, and for trestles which are soon to be filled in.

But today the increased length of piers, now a half mile in length, makes it necessary to use switch engines of the heaviest type on the piers. Locomotive cranes with their heavy concentrations are a common sight, and increased deck loadings combine to create a changed condition. The change is extensive enough to reopen the old question of how much will a pile carry when its slenderness ratio is large, say, 40 to 60. The practice of going ahead, constructing large structures and allowing increasing loads, without increasing our knowledge of long piles as columns, may lead to discredit of engineers. There have been failures due to the weakness of long piles. Two cases were reported in *Engineering News* of July 2, 1908. A similar case was the failure of the White Star Dock in Seattle harbor, about 1902.

For a column whose slenderness ratio is 60, about a dozen well known column formulas give safe loads varying from 0 to 17½ tons. This is assuming a round column substantially the size of a pile and a factor of safety twice as great as ordinarily used in building construction. Confronted with this disagreement of formulas, the need to provide for heavier loads and the practice of omitting bracing in marine locations, is it not time that tests be made approximating actual conditions?

The accompanying drawing gives three half sections of a pier now under construction by the Port of Seattle. This brings clearly before the eye the slenderness of piling often used, especially in the absence of bracing or brace piling. CHAUNCEY WERNECKE.

Seattle, Wash.

Frost Action and Roadbuilding

Sir—The first editorial in the March 4, 1920, issue of your magazine is timely and good; the suggestion contained therein is the only way of saving the apologies we now have, called "highways." The question arises, though, what explanations are commissioners going to offer for curtailing or discontinuing heavy traffic on a particular highway when only a small part of that highway fails when the frost is coming out of the ground? If 75 per cent of a certain stretch of road stands up under the traffic, why should not the other 25 per cent be put in the same shape as the 75 per cent? What excuse can commissioners offer for letting 25 per cent, or even 10 per cent or 5 per cent, of a road hinder traffic year after year while the frost is coming out, and not making even an effort to change conditions for the better?

I am so familiar with the annual break-up of a certain five-mile stretch of state road in this state that I can mark off on the map of that road the places of break-up to within 20 ft. of the ends of the breaks. Notwithstanding this regularity of break-up, not an effort has been made to correct any of the troubles during the six years the road has been in use.

What is the answer?

Jewett City, Conn. A. A. YOUNG.

Vote of "No" Urged on All Proposals in Am. Soc. C. E. Questionnaire

Sir—The referendum that is now before the membership of the American Society of Civil Engineers gives rise to much speculation as to the real reason for the present state of affairs in the society. Certainly they may be described as at least most confusing and there does not appear to be any possibility of getting from the governing body of the society any adequate explanation that would enable one to pass judgment satisfactorily on the issues that are drawn by the present so-called Questionnaire Ballot.

It seems to the writer that the question that might have been put to the membership, and put in English, is: Do you want a strong society of civil engineers to represent the profession and to operate along lines as the membership may direct from time to time? or, Do you want to enter into a mystical union with an as yet unknown body for purposes that can be understood, perhaps, but are not capable of expression?

To my mind the report of the Committee on Development is an incomplete and ambiguous document and I have vainly tried to find out from its pages what becomes of the American Society of Civil Engineers after the locals are formed.

The special committee of the Board of Directors appointed Oct. 14, 1919, to study the report and report its conclusions has evidently had some difficulty in understanding the report, but they call attention to one and, to my mind, the most vital defect in the plan of change where they state: "The plan commits the welfare of the engineering profession to a new and untried organization without history, precedent or experience."

In an effort to try and arrive at an understanding of the present state of affairs one naturally turns to the resolution authorizing the creation of the Committee on Development and here one certainly wonders if "sociological and economic conditions are in a state of flux and are leading to new alignments of the elements of society." The Committee on Development does not explain why a state of flux is good for the American Society of Civil Engineers and why it should fling away all experience and tradition and seek to become a more effective agent either for the engineer or the profession by losing its identity both by division into locals and absorption into an affiliation.

To the writer it seems as though the American Society of Civil Engineers would be best served by a vote of *no* on all of the propositions in the questionnaire, looking forward to the future when the society can be definitely directed along any desired course with a full knowledge of what the changes mean.

J. A. BENSEL,

New York City. Consulting Engineer.

Harder Work Not the Solution

Sir—Mr. Hagerty's letter in your issue of Feb. 26, p. 437, is written in a kindly strain, but on the subject of compensation, civil engineers are not befogged, nor have they lost their poise.

The American desires to improve his position and in order to accomplish that end, many followed civil engineering. To the young man this profession is especially alluring as it combines the mental and the physical. It is congenial to the genius of this country.

Desires and hopes do not create jobs, and the great overcrowding has forced down wages below what will sustain a good standard of living.

The union wages of the tinker, tailor, bricklayer, etc., fix the price of the commodities which the civil engineer must buy. And when he sees himself as the ultimate consumer earning less than the producer, he knows that he is certainly out of luck.

Mr. Hagerty's advice is for the engineer to work harder. Did Mr. Hagerty ever work in a railroad location party in a sage brush country—or set slope stakes—or later on work all day with a party and prospect line after supper? Those who have been through the mill are worked out. Through force of circumstances, and ignorance, the profession is overcrowded. Consequently the engineer, to earn a living, must take radical measures. Engineers do not want unions, but the success of the A. A. E. has demonstrated that engineers have more brains than the old-timers give them credit for. F. W. HARRIS.

Olympia, Wash.

Teach Kiln Drying by Mail

Effective seasoning of wood by kiln drying depends largely upon the operator of the kiln, as noted in *Engineering News-Record* of Nov. 13-20, 1919, p. 853. Following along this line a course of instruction by mail in the art of kiln drying has been worked out by the department of correspondence study of the University of Wisconsin, in conjunction with Arthur Koehler of the U. S. Forest Products Laboratory. This course, which is intended specially for operators, will cover the purpose and difficulties of kiln drying, the wood structure and conditions, the moisture and other factors in seasoning, and the operation of kilns.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Blasting Concrete in Congested Districts

DESPITE the nearness of shopgirls, and the necessity for guarding against destruction of plate-glass and other frail property, dynamite was recently used in New York City in the demolition of a brick and concrete vault formerly occupied by a bank. The walls were 20 in. thick, and the vault 14 ft. long, 12 ft. wide and 7½ ft. high. The roof, supported by six 12-in. I-beams, was 2½ ft. thick. The whole constituted a ton of steel and 49 tons of brick and concrete. The first hole was drilled 13 in. into the wall near the door and loaded with one-third of a cartridge of 40-per cent dynamite. This gave an idea of the size of succeeding charges that could be loaded. Three other holes were then drilled 18 in. apart about 18 in. from the end of the wall and fired with a blasting machine. The job was completed in 14 days at a net profit of $150.

Five plate glass windows 40 ft. from the scene of the blasting were protected by a canvas screen hung from the ceiling and windows in the vicinity were boarded over. Five feet from the wall on one side with but a thin brick wall intervening were girls selling drygoods.

An Economical Cofferdam

By E. H. Sweet
With John A. Stevens, Lowell, Mass.

DURING the construction of a hydro-electric plant for the Jackson Mills at Nashua, N. H., the forebay site was closed off from the river by an economical type of cofferdam, consisting of a skeleton framework

HOW COFFERDAM FRAMEWORK WAS ERECTED ON RAFT AND DELIVERED TO PLACE

of 6 x 6-in. wales, 2 x 10-in. uprights, and ¾-in. tie rods. The wales were spaced about 4 ft. apart vertically with the uprights and tie rods 5 ft. apart.

By using 16-ft. wales and making diagonal lap joints every third tie rod became a hinge, thus making the skeleton continuous and flexible. The framework was erected on a raft and as each section was finished the raft was pushed out from under. The cofferdam was filled with material taken from the power house excavation. This material was sand and gravel and was used as found with the exception that any large stones were thrown out. The side sheeting was simply placed in the framework after it was launched and lightly nailed to the wales just ahead of the fill. Motor trucks filled the whole cofferdam by forming a ramp at the shore end and backing out over the finished fill.

The finished cofferdam is 142 ft. long, 10 ft. wide and 8 to 12 ft. high. The depth of water varied from 3 ft. at the ends to 8 ft. along the major portion of its length.

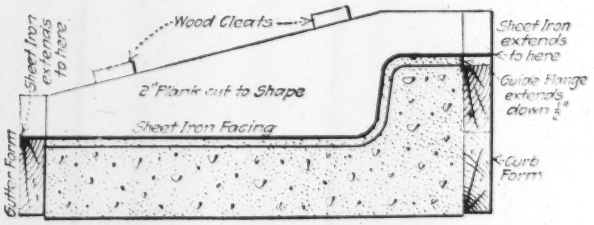
The cost of labor and materials exclusive of any overhead or contractor's profit, for erecting was $12.50 per linear foot. As the fill was taken from the power house excavation the cost of filling was not charged to the cofferdam.

The filling cost $4.50 per linear foot. The cost of removal has not yet been determined.

N. J. Beisel, superintendent for the Raymond Concrete Pile Co., devised the type of cofferdam. The work is being prosecuted in accordance with the plans and under the supervision of John A. Stevens, engineer, Lowell, Mass.

Home-Made Curb and Gutter Finisher

SUCCESSFUL use has been made of a timber sled riding on the side forms to finish concrete combined curb and gutter at Worthington, Minn. The device consists of three ribs cut to the shape of the curb and gutter and held together by two end strips and two cleats as indicated by the sketch. The bottom is sheeted with iron fashioned to the ribs. After the curb and gutter have been molded in the usual manner



SLED RIDING ON SIDE FORMS FINISHES CURB AND GUTTER

the face form is removed and the surface is plastered. Then the sled is set on the side forms and is pushed along smoothing the plaster coat to exact profile. No floating and very little troweling are required to complete the finishing operation. This finisher, according to the *Contractors' Atlas*, was devised by Hanlon & Okes, contractors, of Worthington, Minn.

How an Engineer Got Rich

We have just learned of an engineer who started poor 20 years ago and has retired with the comfortable fortune of $50,000. This money was acquired through industry, economy, conscientious efforts to give full value, indomitable perserverance and the death of an uncle who left the engineer $49,999.50.—[*Official Bulletin, Colorado Society of Engineers.*]

NEWS OF THE WEEK

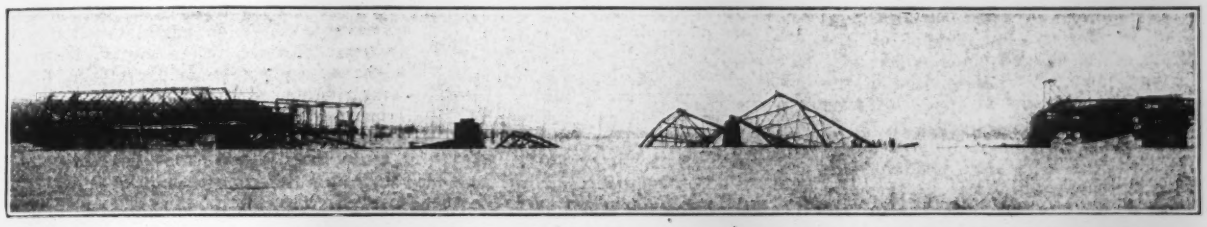
New York, March 18, 1920

Failure of Cohoes-Troy Bridge To Be Investigated

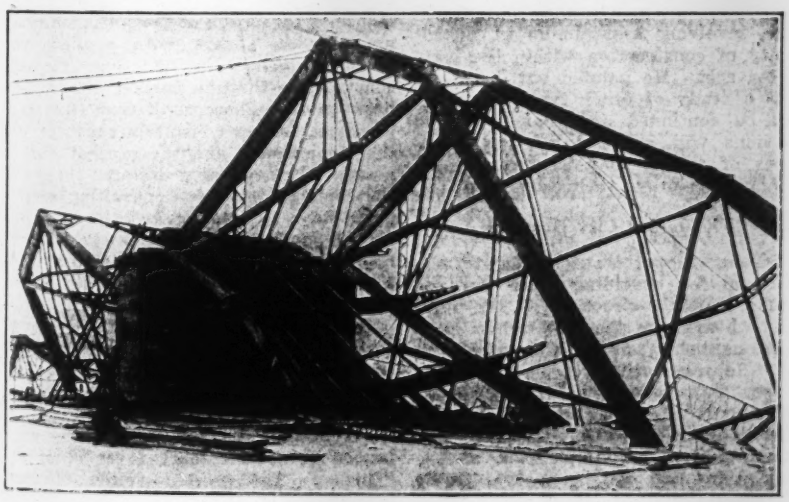
On the evening of March 4 the floor system of the wrought-iron bridge over the Hudson River between Cohoes and Troy, N. Y., caught fire and resulted in the destruction of three intermediate spans and the partial destruction of the westerly span, as reported in the news section last week. The easterly span is not damaged to any extent. The bridge consisted of four fixed spans and a draw span at the Troy end of the bridge. The three intermediate spans were each 175 ft. in length and the easterly and westerly spans were 128 ft. and 158 ft. respectively. The bridge was constructed some forty years ago and was acquired by the State of New York in 1914 at a cost of aproximately $200,000, one-half of which was paid by the State and the remainder by the Counties of Rensselaer and Albany.

A new floor system consisting of creosoted paving block on 3-in. flooring resting on 12-in. stringers was installed in 1918 at a cost of $50,000. The cause of the fire has not been determined and the State and county officials will have a hearing during the coming week to try and determine the cause. The bridge connected 12th St. in Troy with Ontario St. in Cohoes and carried a double-track trolley line.

The lower cords undoubtedly failed by reason of the heat and are completely under water, but on all the upper cords the failure took place at the panel about 10 ft. from the ends of the spans. An examination of the bridge shows on the easterly end of the draw two leads of cables extending from the rails to the northerly end of the drawspan. This cable is not grounded with the trusses. The three spans are now in the river and no information as to the grounding of the rails can be obtained. If the rails were not grounded with the trusses and the superstructure became charged this might have completed a circuit with the rails which would set fire to the stringers upon which rested the rails. It is expected this matter will be taken up at the hearing to be held soon.



THREE SPANS OF COHOES-TROY BRIDGE, WEAKENED BY HEAT FROM BURNING FLOOR, FELL INTO RIVER



VIEW OF STEEL TRUSSES AT ONE OF THE RIVER PIERS

Mississippi Valley Waterways

The Mississippi Valley Waterways Association will hold its annual convention at the Statler Hotel, St. Louis, Mo., on April 19.

Oppose Two-Line Hudson Vehicle Tunnel

National Highway Traffic Association Passes Resolution Favoring Tubes of Larger Capacity Than Those Recommended

Opposition to the two-line, cast-iron vehicular tunnels under the Hudson River, recommended by the chief engineer and endorsed by the board of consulting engineers of the tunnel commissions of New York and New Jersey, developed at a public meeting held March 11 in New York City under the auspices of the National Highway Traffic Association, and culminated in the passage of a resolution calling upon the Governors of the States of New York and New Jersey to withhold approval of the two line tunnel, as at present recommended, and to have made investigations of a larger tunnel than the one now contemplated. The resolution also contained the statement that the traffic capacity of the two-line tunnel was inadequate. The resolution, approved at the open meeting by a mere handful of the organization's membership, will be referred for action to the association's executive committee, but inasmuch as a majority of that Committee was present at the meeting and voted in favor of the resolution there is little doubt as to approval.

The meeting, at which about 75 were present, was opened by the reading of two letters, the first from Stuyvesant Fish, advocating moving platforms for conveying vehicles in the tubes instead of having them operate under their own power, and the other from Edward A. Byrne, of the board of consulting engineers, who had failed to concur in the conculsions of the majority of the board, and who advocated a three-line tunnel, stating that the adoption of a two-line route could be a retrograde step.

After Chief Engineer Clifford M. Holland had outlined the scope of the traffic studies that had formed the basis for designing the tunnels and had showed that the controlling factor governing capacity was not the clear width of roadway but rather the de-

sign and location of entrances and exits so as to prevent traffic congestion in the streets and at the same time assure a steady flow of vehicles to the tubes, the meeting was thrown open for general discussion.

T. Kennard Thomson characterized the capacity of the proposed twin cast-iron tubes as inadequate and offered as a substitute a tunnel containing six 25-ft. passageways, measuring 177 ft. in total width and planned to be built by the trench method. The cost of this tunnel, Mr. Thomson stated, was estimated at $20,000,000, a figure which, in the opinion of John F. O'Rourke, was far too low.

Auto Interests for Three-Line Tubes

Practically all of the representatives of automobile and truck interests objected to the two-line tunnel on the ground of its alleged inadequate traffic carrying capacity. The opinion of the automobile men was strongly in favor of a three-line tunnel. George H. Pride, of the Heavy Haulage Co., predicted that with twin tubes carrying two lines of traffic capacity would be reached almost on the day the route was opened. He took exception to the traffic estimates of the chief engineer of the commission asserting that they were entirely too low. Mr. Holland said, in reply, that a three-line tunnel had been considered by the commissions' engineers and rejected on the ground that it would create at its terminals conditions of street congestion which would prevent the use of the three-line tubes at anything approaching their estimated carrying capacity.

Several objections to the two-line tubes were made on the ground that such a tunnel would be blocked by the breakdown or stalling of motor trucks on grades under the river. John F. O'Rourke, in advocating a double-deck concrete block tunnel to carry three lines of traffic in each direction objected to the high cost of cast-iron for the proposed cast-iron lined tunnels and estimated that the concrete block type of construction would effect a saving of something like $10,000,000 as compared with the construction advocated by the chief engineer of the tunnel commissions.

In making traffic estimates on highways, E. J. Mehren pointed out, it has been the experience of state highway departments that improved hard-surfaced roadways attract traffic from twice to four times greater in volume than that which previously used the road.

Traffic on the existing ferries, it was held by the automobile representatives, is no criterion of the amount of traffic which the tunnels will be called upon to carry. W. P. Eno asserted that a three-line roadway has a traffic capacity at least 60 or 70 per cent greater than a two-line route. The suggestion for an elliptical cast-iron tunnel to carry three lines of traffic each way was answered by Mr. Holland, who stated that such a cross-section would provide inadequate space for the necessary ventilating ducts.

The two-line tunnels were endorsed by Amos L. Schaeffer, consulting engineer to the Borough President of Manhattan, who made the point that it is not conceivable that all traffic desiring to cross the Hudson River can ever be taken care of by a single river crossing. The tunnel capacity, he pointed out, is absolutely dependent upon the ability to handle traffic on the streets at the entrances and exits and it is this consideration which really controls the size of the tunnel rather than its ability to carry two or three lines of traffic, once that traffic has gotten inside the tubes. On the basis of New York experience, Mr. Schaeffer stated, traffic intensity reaches its limit and requires relief when the counts show 0.6 of a vehicle per foot of roadway per minute.

Col. W. J. Wilgus, chairman of the commissions' board of consulting engineers, answered the minority report of Mr. Byrne whose endorsement of a 24 ft. 6 in. width for carrying three lines of vehicles was shown by Colonel Wilgus to be entirely inadequate, allowing only 6 in. of clearance as a total between curbs. Mr. Byrne had originally favored a 23-ft. roadway for three lines of traffic and at a later date revised his figures to 24 ft. 6 in. Colonel Wilgus held that the minimum width for three lines of traffic must be 28 ft. Mr. Byrne's estimate of saving in cost by the three-line tunnel recommended by him was shown to be in error, involving actually an increased cost of $6,000,000 or 21 per cent more than that of the two-line tunnel instead of a 14 per cent increase, as estimated by Mr. Byrne. Mr. Byrne's minority report, according to Colonel Wilgus, contained recommendations which, if carried out, would result in impossible conditions of traffic congestion at the entrances and exits.

Colonel Wilgus asserted that the tunnel commissions had recommended the cast-iron type of construction on the gounds of safety, durability, and economy, involving a minimum of uncertainty of construction within the estimated cost. He pointed out, however, that a study of other types of lining will be continued and that the commissions will ask for bids on other types of tunnel than cast-iron if investigations prove them to be safe.

The Jersey City Hearing

Strong support was given to the proposal for providing three lines of traffic in each direction at the final public hearing of the joint tunnel commissions, held at Jersey City on March 16. Representatives of various New Jersey interests argued that the requirements of traffic will not be met by two-line roadways, and claimed that excessive traffic concentration at the New York end can be dealt with by proper distribution through a better planned approach. Other reasons were urged against the New Jersey approach, which it was said is inadequate in that the roads leading to the tunnel entrance cannot carry the traffic. Among the improvements asked for to relieve this condition are a viaduct from the low ground to the top of Bergen Hill along Twelfth St., and widening of Henderson St. to 100 ft. Jersey City will not be able to make these improvements and take care of the extensive repaving which the tunnel traffic will make necessary.

Technical discussion of tunnel types was continued at this meeting with sharp exchanges of opinion between the engineers of the tunnel and J. F. O'Rourke. Chief Engineer Holland presented a statement giving reasons for the engineers' condemnation of concrete block construction. He made a strong point of the lack of permanency of such a structure because of the destructive effect of percolation of salt water through the joints between blocks, especially as these are filled with grout with much laitance necessarily forming. Cost estimates were also discussed, and on the part of the consulting board the possibility of building a concrete-block tunnel at lower cost than the official design (called "Plan A") was denied. Mr. O'Rourke asserted that if concrete blocks were substituted for the cast-iron lining of the official design they could be made 9 ft. thick without exceeding the cost of the tunnel as designed by the engineers. Gen. Goethals was not present at the hearing, but sent word that he is preparing a full reply to criticisms of his recommendations.

Hudson Tunnel Commission Kills Concrete Block Project

A resolution declaring that concrete-block tunnel construction shall be given no further consideration for the Hudson River vehicle tunnel was adopted by the joint commissions of New York and New Jersey under whose direction the tunnel plans are being developed. The resolution was adopted at the instance of the Board of Consulting Engineers, it is stated, with a view to avoiding delay in starting tunnel construction through further discussion between the adherents of Gen. Geo. W. Goethals, former consulting engineer to the commission, and the present engineers. The resolution declares that, as the chief engineer and consulting engineers have advised against the type of tunnel proposed by Gen. Goethals and its patentee, J. F. O'Rourke, no further time shall be devoted by the engineering staff to consideration of this type.

Gen. Goethals' recommendation was for a single tunnel of 42 ft. exterior diameter, with 36-in. shell made of precast concrete blocks laid up inside a face shield; the tunnel to contain two decks, each providing a 22½-ft. roadway intended to accommodate three lines of vehicles. The present action of the commission specifically condemns this tunnel, but it is interpreted as barring any use of precast concrete blocks for the Hudson River vehicle tunnel.

Joint Congressional Committee on Compensation Reports

After the most thorough investigation ever made of Government employees' compensation and classification, a joint Congressional committee has submitted to Congress a detailed report recommending substantial increases in pay for nearly every class of Government worker. A feature in the recommendations is that providing for a sliding scale of pay conforming with the increasing or decreasing efficiency of the employee.

Senator Jones of New Mexico, chairman of the committee, said the investigation had discovered that, while the present pay for clerical and the lower grades of other services is reasonable and perhaps higher than that for similar work in private employ, the compensation of the technical branches is grossly inadequate. He asserted that the committee had accomplished a work for which there has been a crying need, as the lack of system in Government employment and compensation has done little to prompt efficiency and literally nothing to insure a maintenance of effort. He strongly endorsed the sliding scale feature as the remedy.

All civil engineers in the Government service will participate in the class and compensation revision advised by the report, which will be discussed more fully in next week's issue.

California Engineers Favor Hoover for President

As a result of the action early in January of the San Francisco Joint Council of Engineering Societies in inaugurating a "Hoover-for-President" campaign among engineers, and in circularizing several hundred engineering societies of the country, a large number of letters from societies in all parts of the country have been received at headquarters in San Francisco. While the more conservative societies were unwilling to touch "anything of a political nature" there was a much greater number who showed interest in varying degrees, and on the whole it is the sentiment in San Francisco that the campaign has at least been a factor in drawing engineers together on another common ground. It has been the California purpose to foster preliminary discussion of the matter among engineers in such way as to facilitate more definite organization in case Mr. Hoover becomes a candidate.

Action in San Francisco culminated on March 5 when, in a general meeting at the Engineers' Club, there was formed the "Hoover Republican Club of San Francisco Engineers." C. H. Snyder is chairman of the club and A. H. Halloran is secretary.

In Los Angeles a committee representative of the various technical societies formed the Hoover Technical League of Southern California and sent literature to the 1,400 individual members of their organizations.

New President American Railway Engineering Association

Harry R. Safford, the newly elected president of the American Railway Engineering Association, is assistant to the president of the Chicago, Burlington & Quincy R.R.

Mr. Safford was born at Madison, Ind., and was educated at Purdue University, where he received the master degree of civil engineer. His professional career began in 1895, when he entered the engineering service of the Illinois Central R.R., with which road he was connected for fifteen years. After passing through the positions of rodman, instrumentman and assistant engineer of construction, as well as several general office assignments, he was made division roadmaster in charge of maintenance in 1900. In 1903 he

HARRY R. SAFFORD

became principal assistant engineer, in 1905 assistant chief engineer and in 1907 chief engineer of maintenance-of-way.

He went in 1910 to the Edgar Allen American Manganese Steel Co., as assistant to the president, but returned to railway work in 1911, when he was appointed chief engineer of the Grand Trunk Railway System, which position he held for seven years. In 1918, when the railways were taken over by the Government for the period of the war, he was appointed by the United States Railroad Administration as engineering assistant to the regional director of the central western region. This position he retained until the government returned the railways to private ownership, when he became assistant to the president of the Chicago, Burlington & Quincy R.R. Besides his membership in the American Railway Engineering Association, he is a member of the American Society of Civil Engineers, and until recently a member of its committee on development.

Urge Completion of U. S. Topographic Map

Conference of Federal and Other Mapping Agencies at Washington Opens Way for Co-operative Effort

The map-making conference held in Washington March 9, involving the inter-departmental Board of Surveys and Maps and the non-federal agencies interested in mapping, as outlined in these columns last week, gave evidence of co-operation between Federal bureaus and outside bodies. A similar board for the co-ordination of construction activities already is being discussed. An extract from the opening remarks of O. C. Merrill, chairman of the Board of Surveys and Maps, follows:

"The preparation of a general topographic base map of the United States is proceeding at a rate far too slow to meet either Governmental or private needs. There has been too little consideration given to the adaptation of the special needs of various Government organizations to the general needs of the Government as a whole or to the general requirements of the map-using public. There has been little or no opportunity to secure a general program either for execution by the several departments or for submission to Congress."

In presenting the topographic program of the U. S. Geological Survey, Director Smith stated that the aim to complete the topographic map of the United States for the use of this generation is based upon the fact that only 42½ per cent of the area has been at all adequately mapped and some of it will require resurvey or revision. Nine states are 100 per cent mapped while the others range from 4 per cent, in the case of Mississippi, to 91 per cent for New York.

$40,500,000 To Complete U. S. Map

The cost to complete the map and make the necessary revision is estimated at $40,500,000. In 15 states this mapping program involves an expenditure in excess of $1,000,000, and in three states, Michigan, Minnesota and Texas, the required amount is nearer $2,000,000 each. The plan of increasing expenditures began with $700,000 for the present year, then $1,000,000 for the next fiscal year, and increasing by $500,000 each year to a maximum of $4,500,000 in 1927, the plan being to finish in 1932. The slogan of the Survey's program is "The completed map for this generation."

The estimates as already submitted to Congress for next year include $600,000 for this work by the Geological Survey, and under an Army item it is intended to allot $100,000 to the Geological Survey for mapping of special areas needed for military purposes. It is hoped that the co-operating states may add $400,000, which is twice the amount of this year's co-operation, and thus bring next year's activities up to the scale provided in the projected plan.

Captain P. St. J. Wilson, chief engi-

neer of the Bureau of Public Roads, representing Thomas H. McDonald, chief of the Bureau, said in part:

"The use of these maps in highway construction is invaluable. A great many of the states are entering, or have just entered, upon a program of laying out and establishing state highway systems. Many of them have no maps, and, unfortunately, from that point of view the states which are farther behind with their road programs are also farther behind with the Geological Survey sheets. This is natural, because the more densely populated states are the first in which the Geological Survey began to work. At the same time, those states have been more progressive in their road programs.

"The question was considered so important at the meeting of the State Highway Officials last December at Louisville that they passed a resolution unanimously urging that steps be taken to expedite the making of the maps."

Open Competition for Delaware River Bridge Suggested

In a recent letter sent out in Philadelphia, Clarence W. Brazer, a member of the State Board of Examiners of Architects of Pennsylvania, suggests impartial and open competition in the consideration of plans for the proposed Delaware River bridge. These plans he thinks should then be submitted to a jury of engineers and architects and they in turn should select the bridge site.

"One of the best ways to obtain and consider such plans," writes Mr. Brazer, "is by an impartial and open competition conducted on a well established and equitable program which would furnish each competitor with full information as to the requirements and as to all terrain within the extremes considered available for such location. With the plans submitted in such a competition weighed by a jury on which are both engineers and architects of town planning experience, good judgement and broad vision, the best design should be selected. This would automatically determine whether an engineer or an architect should control the design."

British Roads Advisory Committee Appointed

According to the *Engineer*, London, the Roads Advisory Committee provided for in the Transport Act, has been appointed by the British Minister of Transport. It consists of eleven members, five being representatives of highway authorities, five users of horse and mechanical traction, and one of labor. The first work of the committee will be road classification, a task that has already been begun by the Ministry of Transport. Problems which will come before the advisory committee include those upon engineering, financial and legal questions.

House Votes Separate Army Construction Corps

Representatives Disagree 133 to 74 With Military Affairs Committee to Include in Q. M. Corps

(*Washington Correspondence*)

A decisive over-ruling of the Committee on Military Affairs came when the House of Representatives, as in Committee of the Whole, on March 12, voted overwhelmingly for a separate construction department in the War Department. The bill reported out by the committee placed the Construction Division in the Quartermaster Corps. The amendment providing for the separate construction department was introduced by Representative Sanford of New York. Over the protest of the committee and in spite of allegations of lobbying and questionable methods in the attempt to secure the passage of the amendment, it was adopted 133 to 74. The Sanford amendment reads as follows:

"Sec. 8a. Construction service: The construction service shall consist of one chief of construction with the rank of brigadier general, 250 officers of the grades from colonel to captain, inclusive, and 8,000 enlisted men. The chief of construction, under the authority of the Secretary of War, shall be charged with construction, maintenance, and repair of buildings, structures (other than fortifications) and utilities, and the preparation of plans therefor, in accordance with the requirements of the several arms, corps, bureaus, and services of the Army of the United States, and with the operation of utilities in connection therewith and with acquirement of real estate and issuance of licenses in connection with the military reservations under the jurisdiction of the War Department."

Representative Madden of Illinois, was particularly bitter in his denunciation of the methods which he claimed were being used to secure the passage of the Sanford amendment. "Judging from the number of contractors and material men," he declared on the floor of the House, "who had contracts under this organization during the war, it is the most popular organization in the United States. It does not speak well for an organization to be so popular in the minds of those who are performing contracts under their jurisdiction. I know a lobby is not organized unless there is an interest. If there is an interest, what is it? What interest would you assume the contractors, who made millions under the cost-plus contracts, directed by these men, have in their effort to make a separate organization in the Army, to be known as the Construction Corps?"

Mr. Madden introduced as a portion of his remarks a letter from the Secretary of War in which he expressed the opinion that the Construction Division should be placed under the Chief of Engineers. Mr. Sanford, however, called attention to the fact that the Secretary of War, in view of the very evident disinclination on the part of the House to put the Construction Service in the Engineer Corps, had recommended a separate construction department.

Mr. Madden's reflections on the Construction Service brought down upon his head stinging criticism from fellow members. Representative Reavis, of Nebraska, declared that he had seen no evidence of a lobby but that he never had been afraid to co-operate with bad men to accomplish a good purpose. The question is not whether lobbyists are connected with the matter, he said, but whether it is a meritorious proposition. He expressed the opinion that the pressure was not being exerted in the lobbys but was coming from the people back home.

Most of the speakers in favor of the Sanford amendment set forth arguments showing that the construction corps should be permanently separate from the other divisions of the War Department so that it will be able to expand quickly, without reorganization, in an emergency. The arguments against the separate corps were based largely upon a plea for economy, which could be affected by eliminating many of the officers now on its administrative staff and by reducing its clerical personnel.

The debate in this connection, however, was called to the attention of the Secretary of War who, the day following, wrote to the Chairman of Military Affairs Committee to the effect that his recommendation of the separate Construction Service was made through inadvertence and that he still stands by his recommendation that the Construction Service should go to the Engineer Corps.

Cape Cod Canal Shut Down Pending Ownership Decision

An interesting accompaniment to the return of the railways on March 1 was the temporary shutting down of the Cape Cod Canal. The canal was taken over by the Government during the war and has been operated by the Railroad Administration. Under the recent railway act it presumably was returned to its owner. The owner, however, refused to acknowledge title because during the war Congress ordered the condemnation of the canal appropriating money for its purchase. A jury hearing the condemnation proceedings fixed the value of the canal at $16,801,000. The Government, however, only offered $8,250,000 and when this was refused by the owning company the verdict was appealed. The company now disavows ownership, claiming that the title passed to the Government as a jury verdict. The Government has refused to pay the price fixed by the jury. Meanwhile, the canal on the first of March ceased operation because of no apparent jurisdiction. It is stated, however, that the management and the employees will maintain the canal in operation even though they have no apparent source from which to draw wages.

New York Again Demands Extension of Piers Into Hudson

New York City has made application to the Federal Government for the modification of the pierhead line on the Manhattan side of the North River so as to make a permanent extension of 100 ft. into the river between Pier 47 (Christopher St.) and 22d St., the districts now containing the majority of the trans-atlantic shipping piers. Hearings on the subject are being held by the Harbor Line Board.

The present application is to make permanent an order of 1911, whereby three piers in the Chelsea district were permitted to be extended 100 ft. temporarily. This order was made by the then Secretary of War, after a long controversy in which the Harbor Line Board refused to permit an extension, and was issued as temporary with the expectation that provision would soon be made to care for the long steamships elsewhere than in the most congested part of the river. The permission, however, has been renewed from year to year.

As stated in some detail in *Engineering News*, March 9, 1911, p. 300, encroachments on the fairway of the Hudson and North Rivers have been continuous since 1855 when lines were established. Every five or six years applications have been made, and generally after years of persistent manouvering granted, to move the pierhead line farther and farther into the river. The latest of these was noted in *Engineering News-Record*, Feb. 19, 1920, p. 384, when a re-entrant angle in the lower river was cut across by a new line farther out in the fairway. In 1911, however, the temporary permit was granted only after the Federal Government insisted that this should be the end of encroachment in the upper river, where the New Jersey shore comes closest. Nevertheless, following its consistent policy, New York City now comes forward with the demand that the extension shall not only be made permanent but be made to cover a much longer stretch of shore.

Illinois Abandons Its 1920 Highway Program

Abandonment of its 1920 program of highway construction has been announced by the Division of Highways of the Illinois Department of Public Works. High prices, car shortage and a poor bond market are given as the reasons for the decision. All bids received, except those for 29 miles on the Dixie Highway and 9½ miles on the Chicago-Springfield road, will be rejected. These are Federal aid projects. No roads calling for funds from the $60,000,000 bond issue will be constructed. The bond market is such that a discount of 6 to 7 per cent must be taken if road bonds are sold. At present prices this discount amounts to about $2,500 per mile of concrete road.

Concerning prices the highway officials state that the bids opened on Feb. 11, averaged $42,000 a mile for about 60 miles; the bids opened on Feb. 25, averaged in excess of $47,000 a mile for more than 98 miles; the bids opened on March 3, averaged $44,000 a mile for about 60 miles. On many of the sections there was received only one bid. These prices are exclusive of cement, which is furnished by the state.

Herrold Heads City Planning Board at St. Paul

George H. Herrold, office engineer, Department of Public Works, St. Paul, Minn., has been appointed managing director and engineer of the St. Paul City Planning Board, effective March 15. This is a newly created position brought about by ordinances providing for a study of the physical conditions of the city and the preparation of a comprehensive plan for its future development.

The board has been in existence about a year and during that time has created a public sentiment which has resulted in securing an appropriation of $50,000 to be expended during the next two years for surveys and a plan.

W. B. Greeley to Succeed H. S. Graves as Chief Forester

Colonel W. B. Greeley, assistant forester in the U. S. Forest Service has been appointed chief forester by the Secretary of Agriculture to succeed Colonel Henry S. Graves whose resignation from that office becomes effective May 1.

Colonel Greeley is from California, a graduate of the University of California and the Yale Forest School, and has been in the Forest Service continuously since 1904 except for two years of military service with the American Expeditionary Forces. He is 40 years old. In the Forest Service he has had long and varied administrative experience, advancing through all the technical grades from the lowest to his present position as assistant forester.

To prepare the way for American operations in the French forests, the chief forester, Colonel Graves, was sent to France in 1917. He sent for Colonel Greeley to aid in the work. Colonel Greeley finally became chief of the American Forestry section in charge of 21,000 forestry troops and 95 sawmills.

Colonel Graves' letter of resignation to the Secretary of Agriculture contained the following statement:

"Since the pecuniary return afforded professional and scientific men in the Government service inadequately provides against the exhaustion of their working powers which must inevitably take place in time, and entail sacrifices from which employment elsewhere is free, the only course consistent alike with self respect and a regard for the public interest seems to me to be retirement from office before efficiency has been impaired."

Albert F. Potter, the associate forester tendered his resignation at the same time and for the same reason.

To Spend $1,500,000 on Municipal Work in Pontiac

A series of bond issues is on the voting calendar of Pontiac, Mich., to provide funds for an extensive 1920 program of municipal improvement. Counting one issue for $250,000, voted in January, the combined bond issues will approximate $1,500,000 according to Lloyd W. Fall, assistant city engineer. The money will be spent on concrete and brick paving, sanitary and storm sewers, extensions to the city's water works and an addition to the city hospital. It is also reported that railroad, industrial, business and housing interests in Pontiac are planning the expenditure of more than $7,750,000 in improvements during the year.

Pay Raise for Cornell Faculty

A salary increase of 25 per cent for the faculty of Cornell University has been announced. The increase, which is retroactive to the beginning of the present semester, is the first one of any size granted Cornell instructors in 20 years. It was made possible by the receipt of about one-third of the $10,000,000 endowment fund which the university is campaigning for.

Bethlehem Bridge Bid Rejected

The single bid of T. L. Eyre, of West Chester, Pa., for the construction of the reinforced concrete bridge at Bethlehem, Pa., amounting to $4,871,437, has been rejected by the Pennsylvania Public Service Commission. Mr. Eyre's was the only bid submitted, and is more than $2,500,000 in excess of the engineer's estimate, and approximately 60 per cent more than the amount of money that could be reasonably raised at the present time. For that reason the construction of the bridge will be forgotten temporarily.

U. S. Contractor To Erect Office Buildings in Tokio

Requisitions for equipment for the construction of two modern American steel-frame office buildings in Tokio, Japan, have been received from its Orient branch by the George A. Fuller Co. of New York. Work on the two contracts, which are the first of several which the contracting concern has in prospect in Japan and China, is to start as soon as equipment and materials can be shipped from this country.

The nucleus of the company's Far Eastern branch is a staff of nine who left the United States, Jan. 28 under Henry A. Harris, general manager of operations in the Orient. William Oehrle is manager of the Oriental department of the company's executive office in New York City. With headquarters in Tokio the engineering staff and the skilled labor force is to be increased as fast as the need arises. Several additions to the advance party are now en route.

The two office buildings already contracted for erection in Tokio are each to be of seven stories and of steel,

stone, brick and terra cotta construction with all up-to-date American installations. One of them is for the Japan Steamship Co. (N.Y.K.) and the other for the Japan Oil Co.

Because of indications to its officials that extensive municipal and industrial improvements in both Japan and China are being planned, it is understood the George A. Fuller Co. anticipates contracts for additional construction in that field. This work, it was stated at the New York office, will include public buildings, banks, office buildings, sewers, street improvements and industrial plants.

Memphis To Have New System of Garbage Disposal

A new system of garbage disposal for Memphis, Tenn., is being worked out by City Commissioner Thomas H. Allen whereby the refuse of the city will be divided into garbage, ashes, and rubbish. Each householder will be required to have three receptacles, one for each of the three classes of waste, the garbage holder being required to have a tight lid. A regular schedule for the collection of each kind of refuse is being arranged, this schedule changing somewhat with the seasons. In the summer, garbage will be collected more often than the other two materials. In winter, ashes will have preference. The present mule-drawn carts will be used in addition to autotruck trailers and tractors to collect the refuse.

A contract will be made to sell the garbage to a private concern to feed to hogs. The city will not contract the collection, however, as it is believed that under contract collections there is a tendency to carelessness collecting those wastes which cannot be fed to hogs.

Commissioner Allen is an engineer and was recently elected to office on the commission of the city of Memphis.

Engineering Council for Universal Military Training and Reserve

Engineering Council has adopted unanimously a resolution of its Military Affairs Committee, which declares to be of vital national importance the enactment of legislation for universal military training and the selective organization and training of reserve units. The resolution says also that the careful selection and training of reservists as members of reserve technical service units is essential to the proper preparedness of engineers to discharge their constitutional obligations. The committee is composed of nineteen members of the founder societies, of whom fourteen are former engineer officers, U. S. Army.

Special Libraries Census

All those in charge of special libraries are requested to communicate with William F. Jacob, General Electric Co., Schenectady, N. Y., regarding a special census. Details are given on p. 582 of this issue.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES. Drexel Bldg., Philadelphia; Chicago, Mar. 24, 25.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston; May 4-6; Chicago.

AMERICAN ASSOCIATION OF ENGINEERS; 63 E. Adams St., Chicago; May 10, 11, St. Louis, Mo.

AMERICAN WATER WORKS ASSOCIATION, New York City; Montreal, June 21-26.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Asbury Park, N. J., June 22-25.

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Aug. 30-Sept. 3.

The Cincinnati Association, Am. Soc. C. E., held its first meeting in 22 years, Feb. 26. It was decided to revive the society and to take an active part in civic affairs. Ward Baldwin was elected president and A. M. Westenhoff, secretary and treasurer. Richard L. Humphrey, consulting engineer, Philadelphia, addressed the association on "Enlarging the Activities of the National Society to Take an Active Part in the Economic and Civic Problems of the Country." A committee was appointed to consider the question of affiliation of the society with the Engineers' Club of Cincinnati.

The Milwaukee Chapter, A. A. E., held a meeting, Feb. 24, at which Isham Randolph, Chicago, in an address, advocated the organization of engineers for the promotion of their economic interests as opposed to unions. Secretary C. E. Drayer spoke of the result so far accomplished by the association, outlining the work of the service department and of the railroad department, which has obtained substantial increases for a great majority of the railroad professional engineers of the United States. Over 700 members from Milwaukee, Racine and Kenosha, were in attendance.

The Engineers' Club of Philadelphia makes the following announcement of meetings and luncheons for the coming month: March 19—Illuminating Engineering Society: "Development of the R. L. M. Standards for Industrial Lighting" (illustrated) by Ward Harrison; "Residence Lighting" (illustrated) by M. Luckiesch (Meeting will be held at Cosmos Club, Washington, D. C. March 22—Philadelphia Safety Council. March 23—Tuesday luncheon address: "Merchant Marine Development" by P. H. W. Ross. American Society Mechanical Engineers: "Safeguards in Industrial Plants" by Commander H. A. Richardson, U. S. N. March 26—American Society of Steel Treaters: "Heating Treatment and Furnaces for Heating Treatment" by Henry Voltman. March 30—Tuesday luncheon address: "The Progress of Engineering Council's Work" by Alfred D. Flinn. April 1—Worcester Technology Club. April 3—Association of Iron and Steel Electrical Engineers: "Welding, Electricity Versus Gas" by James E. Wison. April 5—American Society of Civil Engineers. April 6—Renssalaer Polytechnic Club. Tuesday luncheon address. April 7—Technology Club. April 8—American Society of Heating and Ventilating Engineers: "Economizers" (illustrated) by M. C. Sherman. April 12—American Institute of Electrical Engineers: "Electric Welding as Applied to Ship Building" by Comfort A. Adams.

The Portland (Ore.) Association of Members, Am. Soc. C. E., held a meeting in that city March 1. It was reported that at a meeting, Feb. 20, of a committee on the formation of a local technical council, composed of representatives of the American Society of Civil Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Institute of Architects, Northwest Association of Highway Engineers and National Electric Light Association, the Oregon Technical Council was organized and constitution adopted. The board of directors of the association was thereupon authorized to appoint representatives in the council. J. P. Newell, president City Planning Commission, gave an interesting talk on zoning as worked out for the City of Portland and the pending zoning ordinance. The association went on record as favoring the zoning ordinance as it stood and urging its immediate passage by the city council.

The District of Columbia Association of Members, Am. Soc. C. E. held a special meeting at the Cosmos Club Hall, Washington, D. C., Feb. 27, for the purpose of discussing the questionnaire ballot on development now being voted on by the corporate members of the American Society of Civil Engineers. Arthur P. Davis, president of the society, addressed the meeting, and discussed in turn each question to be voted on.

The Southern California Association of Members, Am. Soc. C. E., at its regular meeting, Feb. 11, listened to a paper by Roy V. Reppy, chief counsel of the Southern California Edison Co., on "Political and Legal Aspects of Flood Control in Los Angeles County." W. H. Code delivered a paper on "Financial Features and Executive Organizations Provided in the California Conservancy Act." Among the business matters transacted was the appointment of a committee to consider the voluminous report of the California Railroad Commission on the grade crossing and the union terminal railroad problem in Los Angeles.

The Detroit Engineering Society will be addressed by Prof. Clyde T. Morris, of Ohio State University, on "Stress Measurements," at its meeting of April 2.

PERSONAL NOTES

RUSSELL V. BLACK, recently on the staff of John Nolen, city planner, Cambridge, Mass., has been appointed assistant engineer to the City Planning Commission of Akron, Ohio.

F. M. PERCIVAL has been appointed engineer of Aransas County, Tex.

ARTHUR MAGUIRE, formerly engineer of maintenance-of-way, Los Angeles & Salt Lake R.R., has been appointed chief engineer, with office in Los Angeles, as heretofore.

H. O. KELLEY, formerly assistant engineer, Wabash R.R., St. Louis, has been appointed division engineer, with the same headquarters. He succeeds D. C. Bowman, resigned.

B. H. BRYSON, first engineer, at Fraser, Iowa, Fort Dodge, Des Moines & Southern R.R., has been made chief engineer of that railroad.

B. S. VOORHEES, engineer of grade crossings, New York Central & Hudson River R.R., has been appointed district engineer of the Eastern District (comprising the Hudson River, Harlem, Putnam and Pennsylvania divisions), succeeding G. P. Stowitts, resigned to become chief engineer of the Lord Dry Dock Co., as noted elsewhere. Mr. Voorhees was graduated from Yale University in 1907 and entered the employ of the New York, New Haven & Hartford R.R. A year and a half later he began his service with the New York Central in the maintenance-of-way department at Albany, and soon afterwards entered the Engineering Department as inspector at Watertown, N. Y. Three years later he returned to Albany as assistant engineer, where he remained only a few months, coming to the office of the engineer of grade crossings in New York. He became assistant engineer and in April, 1916, was appointed engineer of grade crossings succeeding N. F. Thompson.

H. D. PARIZEAU, superintendent of hydrographic survey work on Lake Superior for the Department of the Naval Service, Ottawa, has been transferred to the British Columbia district, replacing Captain Burgrave, deceased. (credit Surtees)

R. H. FISH has been appointed general superintendent of eastern lines, Grand Trunk Railway Co., replacing W. R. Davidson, transferred to the western division. Mr. Fish was formerly superintendent of the Stratford, Ont., division. The Ottawa division of the Grand Trunk is under his jurisdiction.

R. J. FRASER, assistant to the superintendent of hydrographic survey work on Lake Superior for the Department of the Naval Service, Ottawa, has been promoted to superintendent replacing H. D. Parizeau, transferred to the British Columbia district.

M. A. STAINER has been appointed engineer of maintenance-of-way, Fort Worth & Denver City Ry. and Wichita Valley R.R.

R. C. GOWDY has been appointed chief engineer, and W. H. Hess valuation engineer, Colorado & Southern Ry., Wichita Valley Ry. and Fort Worth & Denver City Ry.

ALBERT W. NEWTON has been appointed chief engineer of Chicago, Burlington & Quincy R.R., of which he was corporate engineer while it was under Government control.

W. G. CALDWELL, formerly captain, Engineers, U. S. A., has been appointed highway engineer of Waukesha County, Wis., with offices in Waukesha.

R. H. PENNARTZ, formerly on the engineering staff of the Kansas State Highway Commission, has been appointed resident engineer on Federal-aid road work in Shawnee County, Kan.

R. N. KELLOG, Enterprise, Ore., has been appointed highway engineer of Wallowa County, Ore. He will make preliminary plans, specifications and estimates to be used as a basis for extensions and appropriations on work to be done jointly by county and state.

WILLIAM STEEBERGEN, Point Pleasant, W. Va., has been elected road engineer of Jackson County, W. Va. Several miles of concrete road are to be constructed under his supervision this spring.

C. L. NELSON has resigned as city engineer of Muskegon, Mich., to take charge, it is understood, of some of the engineering work on a new plant to be erected in that city by the Campbell, Wyant & Cannot Foundry Co.

ROY F. HALL, Utica, N. Y., has been appointed division engineer, at Watertown, of the New York State Highway Commission. He will be succeeded by L. D. Brownell, who is in temporary charge of the Watertown office.

R. D. KEYES, lieutenant, U. S. Navy, recently discharged, has been appointed engineer on the California State Highway Commission. He has been assigned to new construction work in San Diego County.

BRUCE L. DRAY, attached to the surveyor-general's office, Sacramento, Cal., for the past two years, has been appointed assistant surveyor-general, succeeding Donald Shields, resigned.

EDWIN P. DEWEY, deputy city engineer, Pasadena, Cal., has been made city engineer to succeed R. V. Orbison, who has resigned to become city manager of South Pasadena.

C. M. BUTTS, formerly road engineer of northern California, has been appointed chief assistant to Martin C. Polk, engineer of Butte County, Cal. Mr. Butts will assist in laying out the new county highway provided for under a recent $1,800,000 bond issue.

G. A. NOREN, assistant engineer, New York Central & Hudson River R.R., has been appointed engineer of grade crossings, succeeding B. S. Voorhees, promoted to district engineer, Eastern District, as noted elsewhere. Mr. Noren graduated from the University of Pennsylvania in civil engineering in 1910 and entered the Engineering Department of the Pennsylvania R.R. Soon afterward he became assistant engineer for the Electric Railway, Light & Power Co., Monterey, Mexico. After a brief period of private practice at Monterey, he entered the Engineering Department of the New York Central, where he has served continuously since that time.

D. B. THOMPSON, special assistant contracting engineer, New York Central & Hudson River R.R., has been appointed assistant district engineer of the Eastern District.

HUNTINGTON CHOATE ATWATER, plant engineer, Empire Engineering Co., Inc., New York, has resigned to become vice-president of the Reading Engineering Co., Inc., New York. Mr. Atwater has been engaged for many years on heavy construction work, recently stationed at the Kensico dam as resident engineer for the contractor.

J. P. SPOONER, JR., has been appointed assistant engineer of San Joaquin County, Cal., in charge of highway maintenance.

MAXIMILIAN TOCH, industrial chemist, has been appointed adjunct professor of industrial chemistry of Cooper Union, New York City. Mr. Toch will co-operate in the development of a new four-year day course in industrial chemistry to be started next September by the institution. The course will train men as analysts, research chemists, foremen and superintendents in manufacturing plants.

R. H. FIFIELD, for eight years manager, U. S. Reclamation project, Huntley, Mont., has resigned to take a position with the Billing Land & Irrigation Co., Billings, Mont.

RODERIC PEARSON has been transferred from the Portland, Ore., office to the Missoula, Mont., office, U. S. Bureau of Public Roads, as bridge engineer.

H. J. HEMSTREET, highway engineer, U. S. Bureau of Public Roads, Portland, Ore., has been transferred to the bureau's office at Missoula, Mont.

GEORGE F. TURNER, formerly assistant county surveyor of Mahoming County, has been appointed city engineer of Youngstown, Ohio. For five years previous to his recent employment he was engaged on grade elimination projects for the Pennsylvania Lines. He succeeds Frank M. Lillie, who takes the newly created position of consulting engineer to the City of Youngstown.

J. R. SHIELDS, formerly with the Emergency Fleet Corporation at Ookland, Cal., has been appointed special assistant engineer of the Commission of Public Works of Sacramento. He will have charge of the inspection of materials to be employed in the construction of the new filtration plant for that city.

MARCEL PEQUEGNAT, who for several years has been actively engaged in the municipal affairs of Kitchener, Ont., as resident engineer of the Kitchener Water Commission and assistant city engineer, has been made superintendent and engineer of the commission.

T. R. DEACON, of the Manitoba Bridge & Iron Works, has recently been elected vice-president of the Manitoba Branch of the Deep Waterways Association.

PROF. J. J. TRAILL, assistant professor in hydraulics of the University of Toronto, with which institution he has been associated for fourteen years, has resigned to enter the hydraulics department of the Hydro-Electric Power Commission of Ontario.

BLUM, WELDIN & CO., of Pittsburgh, have been appointed consulting engineers to the comptroller of Allegheny County, Pa., under whose jurisdiction is the approval of all contracts and payment under contracts for county work. The above-mentioned firm has been selected to advise him on all technical matters involved.

SPENCER LOGAN, of Cherryvale, Kan., has been appointed city engineer of Coffeyville, Kan., for which city extensive municipal improvements are planned in the way of a new sewerage system and street paving.

D. H. TOMLINSON, assistant secretary, American Association of Engineers, in charge of the railroad sections at headquarters in Chicago, has become identified with the Portland Cement Association. Mr. Tomlinson, who was assistant engineer on the Chicago & Western Indiana Ry. previous to his service as captain and instructor in the Field Artillery, U. S. A., at Fort Monroe, has held the difficult position of taking up the compensation question of the railroad engineers with the regional directors.

LANGDON PEARSE and SAMUEL A. GREELEY announce that PAUL HANSEN, recently chief sanitary engineer, Illinois State Department of Health, has become a member of their organization. The firm name will be Pearce, Greeley & Hansen, with offices in Chicago. The new firm will continue the general practice of hydraulic and sanitary engineering, Mr. Greeley and Captain Hansen as active partners and Mr. Pearse as special consultant.

J. B. EARLY has been made resident engineer of Foard County, Tex. He was formerly office engineer for W. M. Foshee, engineer of Lamar County, Tex.

OBITUARY

H. T. RUHL, formerly an engineer on the Canadian Pacific Railway and the Canadian Government Railways, died of pneumonia, at Albany, N. Y., Feb. 18. Mr. Ruhl, an American by birth, spent a large part of his life in Canada, chiefly with the Canadian Government Railways, as divisional engineer, at Moncton. He was associated with F. P. Gutelius on the Canadian Pacific, and the Government Railways. Later he was engineer of maintenance-of-way of the Delaware & Hudson, with headquarters at Albany, which position he held up to the time of his death.

DANIEL DECKER MARTLING, one of the builders of the Atlantic Ave. tunnel, Brooklyn, and at one time superintendent of the old Culver steam railroad, between Brooklyn and Coney Island, which he helped to build, died at his home in that city, of heart failure, Feb. 6.

DANIEL BERNARD MCCARTHY, eastern sales manager, Neptune Meter Co., New York, died from bronchial pneumonia at his home in that city, Mar. 6. He was born in Weavertown, N. Y., in 1871. Following a course in the Troy Business College, Mr. McCarthy was in charge for about a year of the Watervliet, N. Y., waterworks plant. He then moved to Waterford and became superintendent of the Waterford Water Co., continuing in that capacity for nearly twenty-one years. During his management of the Waterford plant, he became associated with the Neptune Meter Co. and represented that concern as a traveling representative for seventeen years. In 1014 he was made eastern sales manager of the company, in direct charge of sales for a large portion of the country.

JAMES ROGERS, railroad contractor, died at his home in Montreal, March 1. He was born at River Beaudette, Que., in 1837. Mr. Rogers started his career as subcontractor in the construction of the Canadian Pacific R.R. on Lake Superior. At a later date he constructed part of the Sudbury & Canadian Pacific R.R. lines, and was superintendent of construction in the building of the Canadian Pacific R.R. west of Port Arthur, and also built a portion of the Baie des Chaleurs Railway running from Metapedia Junction. He built a section of the Intercolonial Railway, near Newcastle and Chatham, N. B., double tracked the Grand Trunk from Hamilton to Niagara Falls and from St. Lambert to St. Johns, Que. Other public works which he undertook were the construction of the Atwater Ave. bridge over the Lachine Canal, in which the first extensive use of reinforced concrete was made; also the New York Central R.R. from Valleyfield to Malone, N. Y., and Fort Covington to Massena Springs, N. Y. Mr. Rogers was also at one time a government inspector of construction in the building of the North Shore R.R. between Montreal and Quebec.

BUSINESS NOTES

LOWELL WRENCH CO., Worcester, Mass.; catalog, 6 x 9 in., 20 pages, illustrated; "Reversible Ratchet Wrenches," describes ratchet equipment for drills, taps and dies, all thread connections, and for vises.

K. R. WILSON, Buffalo, N. Y.; catalog, 3 x 9 in., 20 pages, illustrated; "Wilson's Special Tools for Ford Repair Shops," describing a line of shop equipment especially adapted to Ford car repairing.

ELECTRO BLEACHING GAS CO., Niagara Falls, N. Y.; booklet, 5 x 8 in., 18 pages, illustrated; "Liquid Chlorine," describing the various uses of liquid chlorine and the company's service in its supply.

THE EASTON CAR & CONSTRUCTION CO., Easton, Pa., has opened a branch office at 400 Penobscot Bldg., Detroit, in charge of H. H. Siff, district sales engineer. With this new branch office, the company states, industrial railway users may secure quick, accurate and dependable engineering service and the solution of difficult problems in special equipment.

THE WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa., announces the following promotions among its East Pittsburgh officials: Alexander Taylor, from manager of works, to assistant to vice-president in general charge in all plants of production, stocks and stores; R. L. Wilson, from general superintendent, to works manager, East Pittsburgh works; E. R. Norris as director of works equipment, in charge of machinery, tools and methods in the various plants.

THE GENERAL ELECTRIC CO., Schenectady, N. Y., announces the establishment of business training course for college graduates without a technical education. The course is also being extended to include the graduates of technical colleges employed in the company's testing department, with the idea of giving the prospective engineer a broad business background for his future work. Students taking this course will be paid by the company. The company now employs in its technical department from four to five hundred college graduates every year. There are included in this enrollment students representing twenty foreign countries. The International General Electric Co., Inc., a separate organization recently formed to handle the foreign business of the parent concern, also expects to establish a similar course of training for students who will represent it in foreign countries.